



Zootaxa 3998 (1): 001–138

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# Monograph

<http://dx.doi.org/10.11646/zootaxa.3998.1.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:6FDBE67E-7534-41EA-90E0-A09250D702DB>

ISSN 1175-5326 (print edition)

**ZOOTAXA**

ISSN 1175-5334 (online edition)

# ZOOTAXA

3998

## Revision of the Neotropical species of the caddisfly genus *Wormaldia* McLachlan (Trichoptera: Philopotamidae)

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Magnolia Press  
Auckland, New Zealand

*Accepted by J. Morse: 1 Jul. 2015; published: 6 Aug. 2015*

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FERNANDO J. MUÑOZ-QUESADA & RALPH W. HOLZENTHAL  
**Revision of the Neotropical species of the caddisfly genus *Wormaldia* McLachlan**  
**(Trichoptera: Philopotamidae)**  
(*Zootaxa* 3998)

138 pp.; 30 cm.

6 Aug. 2015

ISBN 978-1-77557-763-8 (paperback)

ISBN 978-1-77557-764-5 (Online edition)

FIRST PUBLISHED IN 2015 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: [zootaxa@mapress.com](mailto:zootaxa@mapress.com)

<http://www.mapress.com/zootaxa/>

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ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

## Table of contents

Abstract	4
Resumen	4
Introduction	5
Taxonomic review	5
Material and methods	6
Generic diagnosis	8
Species descriptions	9
<i>Wormaldia alicia</i> Bueno-Soria, Santiago-Fragoso, & Barba-Alvarez	9
<i>Wormaldia andrea</i> Muñoz-Quesada & Holzenthal, new species	9
<i>Wormaldia anhelitus</i> Muñoz-Quesada & Holzenthal, new species	10
<i>Wormaldia araujoi</i> Muñoz-Quesada & Holzenthal, new species	12
<i>Wormaldia arizonensis</i> (Ling)	13
<i>Wormaldia aymara</i> Muñoz-Quesada & Holzenthal, new species	14
<i>Wormaldia barbai</i> Muñoz-Quesada & Holzenthal, new species	15
<i>Wormaldia bolivari</i> Muñoz-Quesada & Holzenthal, new species	16
<i>Wormaldia boteroi</i> Muñoz-Quesada & Holzenthal, new species	17
<i>Wormaldia buenorum</i> Muñoz-Quesada & Holzenthal, new species	18
<i>Wormaldia calderonae</i> Muñoz-Quesada & Holzenthal, new species	19
<i>Wormaldia chrismark</i> Muñoz-Quesada & Holzenthal, new species	20
<i>Wormaldia contrerasi</i> Muñoz-Quesada & Holzenthal, new species	21
<i>Wormaldia cornuta</i> Bueno-Soria & Holzenthal	22
<i>Wormaldia dachiardiorum</i> Muñoz-Quesada & Holzenthal, new species	23
<i>Wormaldia dampfi</i> Ross & King	24
<i>Wormaldia dorsata</i> Ross & King	25
<i>Wormaldia eberhardi</i> Muñoz-Quesada & Holzenthal, new species	26
<i>Wormaldia endonima</i> Ross & King	27
<i>Wormaldia esperonis</i> Ross & King	28
<i>Wormaldia flinti</i> Muñoz-Quesada & Holzenthal, new species	28
<i>Wormaldia francovilla</i> Muñoz-Quesada & Holzenthal, new species	29
<i>Wormaldia fredycarol</i> Muñoz-Quesada & Holzenthal, new species	30
<i>Wormaldia gallardoi</i> Muñoz-Quesada & Holzenthal, new species	31
<i>Wormaldia gonzalezae</i> Muñoz-Quesada & Holzenthal, new species	34
<i>Wormaldia hedamafera</i> Muñoz-Quesada & Holzenthal, new species	34
<i>Wormaldia imberti</i> Muñoz-Quesada & Holzenthal, new species	36
<i>Wormaldia inca</i> Muñoz-Quesada & Holzenthal, new species	37
<i>Wormaldia insignis</i> (Martynov)	38
<i>Wormaldia isela</i> Muñoz-Quesada & Holzenthal, new species	39
<i>Wormaldia juarox</i> Muñoz-Quesada & Holzenthal, new species	40
<i>Wormaldia lauglo</i> Muñoz-Quesada & Holzenthal, new species	41
<i>Wormaldia luma</i> Bueno-Soria & Holzenthal	42
<i>Wormaldia machadorum</i> Muñoz-Quesada & Holzenthal, new species	43
<i>Wormaldia maesi</i> Muñoz-Quesada & Holzenthal, new species	44
<i>Wormaldia matagalpa</i> Flint	44
<i>Wormaldia menchuae</i> Muñoz-Quesada & Holzenthal, new species	45
<i>Wormaldia monsonorum</i> Muñoz-Quesada & Holzenthal, new species	46
<i>Wormaldia navarroae</i> Muñoz-Quesada & Holzenthal, new species	47
<i>Wormaldia palma</i> Flint	48
<i>Wormaldia paprockevi</i> Muñoz-Quesada & Holzenthal, new species	49
<i>Wormaldia planae</i> Ross & King	50
<i>Wormaldia proluxa</i> Flint	54
<i>Wormaldia savoriorum</i> Muñoz-Quesada & Holzenthal, new species	55
<i>Wormaldia tarasca</i> Bueno-Soria & Holzenthal	56
<i>Wormaldia tocajoma</i> Muñoz-Quesada & Holzenthal, new species	57
<i>Wormaldia trondi</i> Muñoz-Quesada & Holzenthal, new species	58
<i>Wormaldia tupacamara</i> Muñoz-Quesada & Holzenthal, new species	59
<i>Wormaldia zunigae</i> Muñoz-Quesada & Holzenthal, new species	60
<i>Wormaldia zunigarceorum</i> Muñoz-Quesada & Holzenthal, new species	61
Key to males of Neotropical <i>Wormaldia</i> species	62
Acknowledgements	66
References	66

## Abstract

*Wormaldia* McLachlan 1865 is the 2nd largest genus in the family Philopotamidae (Trichoptera) after *Chimarra* Stephens 1829 and is diverse and widely distributed, with ca. 175 extant species in all biogeographic regions except the Australasian. In this monograph, 14 previously described species are recognized for the Neotropical region: *W. alicia* Bueno-Soria, Santiago-Fragoso, & Barba-Alvarez 2005 [Mexico]; *W. arizonensis* (Ling 1938) [Mexico, USA]; *W. cornuta* Bueno-Soria & Holzenthal 1986 [Mexico]; *W. dampfi* Ross & King 1956 [Mexico, Nicaragua]; *W. dorsata* Ross & King 1956 [Mexico]; *W. endonima* Ross & King 1956 [Mexico]; *W. esperonis* Ross & King 1956 [Mexico]; *W. insignis* (Martynov 1912) [Peru]; *W. luma* Bueno-Soria & Holzenthal 1986 [Mexico]; *W. matagalpa* Flint 1995 [Costa Rica, Guatemala, Nicaragua]; *W. palma* Flint 1991 [Colombia]; *W. planae* Ross & King 1956 [southwestern USA, Mexico, Caribbean, Central America, and northern South America]; *W. proluxa* Flint 1991 [Colombia]; and *W. tarasca* Bueno-Soria & Holzenthal 1986 [Mexico]. Also, 36 additional Neotropical species are newly diagnosed, described, and illustrated: *W. andrea* [Ecuador]; *W. anhelitus* [Central America]; *W. araujoi* [Ecuador]; *W. aymara* [Bolivia]; *W. barbai* [Mexico]; *W. bolivari* [Venezuela]; *W. boteroi* [Colombia]; *W. buenorum* [Mexico]; *W. calderonae* [Mexico]; *W. chrismark* [Panama]; *W. contrerasi* [Panama]; *W. dachiardiorum* [Colombia]; *W. eberhardi* [Panama]; *W. flinti* [Bolivia, Panama]; *W. francovilla* [Panama]; *W. fredycarol* [Costa Rica, Panama]; *W. gallardoi* [Costa Rica, Panama]; *W. gonzalezae* [Venezuela]; *W. hedamafera* [Costa Rica, Nicaragua]; *W. imberti* [Costa Rica]; *W. inca* [Peru]; *W. isela* [Mexico]; *W. juarox* [Costa Rica]; *W. lauglo* [Panama]; *W. machadorum* [Costa Rica, Panama]; *W. maesi* [Nicaragua]; *W. menchuae* [Guatemala]; *W. monsonorum* [Costa Rica]; *W. navarroae* [Mexico]; *W. paprockevi* [Costa Rica]; *W. savoriorum* [Panama]; *W. tocajoma* [Costa Rica]; *W. trondi* [Costa Rica, Panama]; *W. tupacamara* [Bolivia]; *W. zunigae* [Colombia]; and *W. zunigarceorum* [Costa Rica, Panama]. In addition, the species *W. arcopa* Denning 1966 from Panama is considered a junior subjective synonym of *W. planae*. Furthermore, new distribution records for the Neotropical region for several species are given. Diagnoses, redescrptions, and illustrations of the male genitalia of the other 14 described Neotropical species in the genus are also presented. Illustrations of the forewing and hind wing of 19 species are also given. A structural terminology for male tergum X is proposed. Finally, a key for identification of males of all Neotropical species is provided.

**Key words:** new species, redescrptions, identification key, distribution records

## Resumen

*Wormaldia* McLachlan 1865 es el segundo género más diverso y ampliamente distribuido de la familia Philopotamidae (Trichoptera), después de *Chimarra* Stephens 1829 (aproximadamente 175 spp. en todas las regiones biogeográficas, excepto en la región Australiana). En esta monografía, 14 especies previamente descritas son reconocidas para la región Neotropical: *W. alicia* Bueno-Soria, Santiago-Fragoso, y Barba-Alvarez 2005 [México]; *W. arizonensis* (Ling 1938) [México, E. U. A.]; *W. cornuta* Bueno-Soria y Holzenthal 1986 [México]; *W. dampfi* Ross y King 1956 [México, Nicaragua]; *W. dorsata* Ross y King 1956 [México]; *W. endonima* Ross y King 1956 [México]; *W. esperonis* Ross y King 1956 [México]; *W. insignis* (Martynov 1912) [Perú]; *W. luma* Bueno-Soria y Holzenthal 1986 [México]; *W. matagalpa* Flint 1995 [Costa Rica, Guatemala, Nicaragua]; *W. palma* Flint 1991 [Colombia]; *W. planae* Ross y King 1956 [suroeste de E. U. A., México, Caribe, Central y norte de América del Sur]; *W. proluxa* Flint 1991 [Colombia]; y *W. tarasca* Bueno-Soria y Holzenthal 1986 [México]. Asimismo, 36 especies neotropicales adicionales no descritas aún son diagnosticadas, descritas e ilustradas: *W. andrea* [Ecuador]; *W. anhelitus* [América Central]; *W. araujoi* [Ecuador]; *W. aymara* [Bolivia]; *W. barbai* [México]; *W. bolivari* [Venezuela]; *W. boteroi* [Colombia]; *W. buenorum* [México]; *W. calderonae* [México]; *W. chrismark* [Panamá]; *W. contrerasi* [Panamá]; *W. dachiardiorum* [Colombia]; *W. eberhardi* [Panamá]; *W. flinti* [Bolivia, Panamá]; *W. francovilla* [Panamá]; *W. fredycarol* [Costa Rica, Panamá]; *W. gallardoi* [Costa Rica, Panamá]; *W. gonzalezae* [Venezuela]; *W. hedamafera* [Costa Rica, Nicaragua]; *W. imberti* [Costa Rica]; *W. inca* [Perú]; *W. isela* [México]; *W. juarox* [Costa Rica]; *W. lauglo* [Panamá]; *W. machadorum* [Costa Rica, Panamá]; *W. maesi* [Nicaragua]; *W. menchuae* [Guatemala]; *W. monsonorum* [Costa Rica]; *W. navarroae* [México]; *W. paprockevi* [Costa Rica]; *W. savoriorum* [Panamá]; *W. tocajoma* [Costa Rica]; *W. trondi* [Costa Rica, Panamá]; *W. tupacamara* [Bolivia]; *W. zunigae* [Colombia]; y *W. zunigarceorum* [Costa Rica, Panamá]. La especie *W. arcopa* Denning 1966 de Panamá es considerada sinonimia (*junior subjective synonym*) de *W. planae*. Además, nuevos registros de distribución para varias especies de la región Neotropical son aportados. Son presentadas las diagnosis, redescrpciones e ilustraciones del genital del macho de las 14 especies neotropicales ya descritas previamente de este género. Ilustraciones de alas anterior y posterior de 19 especies son suministradas. Es propuesta una terminología estructural para el tergo X del genital del macho. Finalmente, se ofrece una clave dicotómica de identificación de los machos de todas las especies neotropicales conocidas.

**Palabras clave:** nuevas especies, redescrpciones, clave de identificación, registros de distribución



## Introduction

The genus *Wormaldia* was established by McLachlan 1865 within the family Philopotamidae. Species are found in all faunistic regions except in the Australian and Antarctic. In the Neotropical region, this family is represented by *Wormaldia*, *Chimarra* Stephens 1829, *Chimarrhodelia* Lestage 1925, *Sortosa* Navás 1918, and *Alterosa* Blahnik 2005. The species of *Wormaldia* are found only in the Brazilian subregion of the Neotropics at present (Flint 1976; Flint *et al.* 1999; Ross 1967).

In the Neotropics, adult *Wormaldia* are found on vegetation growing around small streams and waterfalls in forested, mountainous areas. They are small (4–8 mm) with blackish or brown coloration, and are crepuscular and nocturnal in activity. The immature stages of the Neotropical species of *Wormaldia* have not yet been described (Pes *et al.* 2005, 2014), but the larvae from other regions are usually encountered on rocks or woody substrate in running waters where they are kept constantly moist. They build silken tubular retreats in which they freely move and in this way feed by cleaning fine organic particles from the tube's inner surfaces (Wiggins 1996). Larval descriptions and diagnoses of species from Europe (Lepneva 1970; Waringer & Graf 2013) and North America (Muñoz-Quesada & Holzenthal 2008; Ross 1944; Wiggins 1996) have been given.

The need for a modern taxonomic revision for the Neotropical fauna of *Wormaldia* has grown as new species have been discovered and described. In addition, many original descriptions do not have illustrations of the male genitalia or the male genitalia were only partially illustrated, while other descriptions or diagnoses were principally based on the wing venation and other body parts, but not on the male genitalia. Finally, an identification key to males for all known Neotropical species has never been provided.

The main objective of this study is to provide a comprehensive taxonomic revision of the Neotropical species of the genus *Wormaldia*. For this reason, the descriptions and diagnoses have been schematically and uniformly designed for easier use by workers unfamiliar with caddisfly taxonomy. In addition, for the 14 previously known Neotropical species (except *W. alicia* Bueno-Soria, Santiago-Fragoso, & Barba-Alvarez, see below) we provide redescriptions, diagnoses, illustrations of the male genitalia, new distributions records, and for some species illustrations of the forewing and hind wing. We provide similar information for the 36 undescribed species. A structural terminology for male tergum X is proposed (Fig. 6). Finally, an identification key for the males of the all known Neotropical species is given.

In this study, the species *W. arcopa*, described by Denning (in Denning & Sykora 1966) from Panama is considered a synonym of *W. planae* Ross & King (in Ross 1956) from Mexico. In addition, new distributional records are given for the Neotropical range extension for *W. arizonensis* (Ling 1938). Accordingly, 28 *Wormaldia* species are present in the New World (Flint *et al.* 1999). The Nearctic region has 17 recognized species (Muñoz-Quesada & Holzenthal, 2008) and the Neotropical Region 14 species (Flint *et al.* 1999); *W. arizonensis* and *W. planae* are found in both regions of the New World.

## Taxonomic review

In 1865, McLachlan erected the genus *Wormaldia* within the family Philopotamidae. A complete synonymy of genus-group names is provided on the *Trichoptera World Checklist* (Morse 2015) and by Muñoz-Quesada & Holzenthal (2008). In 1912, Martynov described the first species from the Neotropical region (Peru) and the New World, *Wormaldia insignis*, originally *Dolophilus insignis*. From 1912 to 1944, several Nearctic *Wormaldia* species were described within other genera including *Paragapetus* Banks 1914, *Dolophiliella* Banks 1930, and *Dolophilus* McLachlan 1868. In 1944, Ross concluded that the genera *Paragapetus* and *Dolophiliella* were synonyms of *Dolophilus*.

In 1949, Ross synonymized the genus *Dolophilus* with the genus *Wormaldia*. Therefore, all species listed by him in 1944 were transferred to *Wormaldia*. Consequently, *Dolophilus insignis* was also transferred to *Wormaldia*. In addition, Ross designated *Hydropsyche occipitalis* Pictet 1834 as the type species of *Wormaldia*, and provided a species group proposal. He erected 3 species groups for the 10 Nearctic species recognized until then, the *W. major* Group, *W. arizonensis* Group, and *W. moesta* Group.

In 1956, Ross provided a complete phylogenetic revision of the World fauna of the genus and also considered its biogeographic aspects. In this study, he included the genus *Doloclanes* Banks 1937 as a subgenus within the

genus *Wormaldia* (*sensu lato*). In addition, he synonymized the genera *Nanagapetus* Tsuda 1942 and *Gatlinia* Ross 1948 under *Doloclanes*, which has a single species *D. mohri* (Ross) in the New World (southeastern USA). For *Wormaldia* (*sensu stricto*), Ross (1956) reassessed his former species group proposal for the Nearctic species (Ross 1949), to include the following species groups: the *W. anilla* Group, *W. arizonensis* Group, and *W. moesta* Group. Finally, in this work 11 new species were described: 4 *Doloclanes* species from eastern Asia and 7 *Wormaldia* species from Africa (Madagascar) and the New World. By that time, 44 years after Martynov's first description of a species *Wormaldia* from the Neotropics, the following additional Neotropical species had been added to *Wormaldia*: *W. dampfi*, *W. dorsata*, *W. endonima*, *W. esperonis*, and *W. planae*, all described by Ross & King (in Ross 1956) from Chiapas, Mexico, and *W. ostina* described by Ross in 1956 from Peru. These 6 Neotropical species were placed within species groups as follows: *W. dorsata* and *W. endonima* within the *W. anilla* Group, and *W. dampfi*, *W. esperonis*, *W. planae*, and *W. ostina* within the *W. arizonensis* Group. In summary, Ross's 1956 revision for the World fauna of *Wormaldia* (*sensu stricto*) listed 30 living species, 3 fossil species, and 3 unplaced species, which were placed in 9 species groups. Of the 36 described species, 18 species were from the New World with 7 of these from the Neotropical Region. The 7 Neotropical species were all considered to be in the subgenus *Wormaldia*, 2 within the *W. anilla* Group and 5 within the *W. arizonensis* Group.

Subsequently, Denning described *W. arcopa* from Panama (in Denning & Sykora 1996), and considered it a member of the *W. arizonensis* Group. In 1975, Flint determined that *W. ostina* Ross 1956 was a synonym of *W. insignis*. In 1986, Bueno-Soria and Holzenthal described 3 new species from Mexico within the *W. arizonensis* Group: *W. cornuta*, *W. luma*, and *W. tarasca*. In 1991, Flint described *W. palma* and *W. proluxa* from Colombia, and in 1995, he described *W. matagalpa* from Nicaragua, all were placed within the *W. arizonensis* Group. In 1999, Flint *et al.* (1999) recorded the range extension of *W. arizonensis* into the Neotropics. In 2008, Muñoz-Quesada & Holzenthal reported the range extension of *W. planae* into the Nearctic Region, and also described 2 new Nearctic species, *W. birneyi* from California U.S.A., and *W. clauseni* from British Columbia, Canada.

## Material and methods

### Collecting and preserving specimens

Methods used for collecting, preserving, and curating Trichoptera specimens examined in this work were those commonly used for entomological studies (Martin 1977; Blahnik 1998). For collecting Trichoptera adults, specimens were attracted using ultraviolet and mercury vapor lights placed in front of a white bed sheet erected adjacent to water courses. Individuals landing on the sheet were collected in potassium cyanide kill jars and subsequently pinned. An alternative collecting method included the use of alcohol traps with white or ultraviolet light (Blahnik & Holzenthal 2004; Calor & Mariano 2012).

### Preparing and storing genitalia

For genitalia preparation, the male abdomen was cut from the body, preferably as close to the thorax as possible. The separated abdomen containing the terminal genitalia were cleared using 10% KOH. After clearing, the internal contents were cleaned out using a small syringe with water. The cleared and cleaned genitalia were transferred to 10% acid alcohol for about 1 minute. Later, they were transferred to a microvial with 80% ethyl alcohol for permanent storage with the remainder of the specimen in a vial of alcohol. For examination of pinned specimens, the same procedure was used, except the cleared genitalia were placed in a microvial with glycerin and pinned beneath the remainder of the dry specimen.

Because of the membranous nature of tergum X, and also because tergum X was sometimes rendered very light by the clearing process, chlorazole black E (Sigma-Aldrich) dissolved in water was used for staining the male genitalia. For staining, genitalia were placed in the stain for several hours.

### Morphological considerations

In general, terminology used for structures of the male genitalia follows that presented by Muñoz-Quesada & Holzenthal (2008). In the present paper, a detailed explanation of the structural composition of tergum X is given below. The posterior margins of sterna VII and VIII of some Neotropical species each possess a usually convex projection, here considered a short extension of the posterior margin of its sternum (Figs. 13, 20, 44, 92).

Morphological variation was observed in some structures of the male genitalia in specimens of several species, as described in the respective diagnosis. Other morphological variation may be observed, apparently sometimes occurring naturally, but also originating due to distortions of the cuticle during the clearing and cleaning processes of the genitalia. For these reasons, for workers unfamiliar with the genus, it is recommended that a combination of several diagnostic morphological characters be used, as well as other resources (diagnoses, descriptions, illustrations, distributional data), to confidently identify *Wormaldia* species.

The forewings and hind wings were illustrated for 19 Neotropical species and their costa, subcosta, medius, radius, and anal veins were labeled, as well as their apical forks. Crossveins and cells were also labeled in the wing illustrations of *W. arizonensis* (Figs. 226–227). Finally, the diagnoses are meant to be comparative and schematic and they, along with the identification key are strictly based on morphological characters of the male genitalia.

#### Tergum X

Tergum X of the Neotropical species of *Wormaldia* generally occurs in 2 forms, here defined as the simple prototype and the complex prototype. The simple prototype is characterized by having a triangular or nearly triangular shape and being structurally simple, without processes, and nearly acute or narrowly rounded apically (Fig. 2). This simple prototype is seen in *W. dampfi* and *W. endonima* (Figs. 38–39, 42–43, respectively), as well as by the known species of *Wormaldia* of the Nearctic region (see illustrations by Muñoz-Quesada & Holzenthal, 2008), with the exception of *W. arizonensis* and *W. planae* (Figs. 222 and 249, respectively).

The complex prototype of tergum X is characterized by having a subtriangular shape and being structurally complex, with at least 1 or more structural components or processes at midlength or/and with anterior and lateral apices posteriorly (Fig. 6). This complex prototype is found in all known species of *Wormaldia* in the Neotropical region, with the exception of *W. dampfi* and *W. endonima* (Figs. 38–39 and 42–43, respectively).

Because of the multifaceted composition of the complex prototype of tergum X, we here propose a structural terminology, which will facilitate the description and identification of the Neotropical species of this genus. This new terminology proposal is illustrated for tergum X of a hypothetical male genitalia of *Wormaldia* shown in Fig. 6. Accordingly, the complex prototype of tergum X is elongate-subtriangular and consists of the following structural components:

**process “a”:** absent or present anteromesally, unpaired, conspicuous, diversely developed in shape (usually lambda or Y-shaped [inverted in orientation of dorsal view in figures]), sometimes reaching middle of tergum.

**process “b”:** absent or present sublaterally, paired, conspicuously or slightly developed, usually triangularly or convexly projected laterad.

**head of tergum:** conspicuously or slightly developed, nearly triangular, triangular, ovate, or balloon-shaped; with one of the following apices (or head without apices):

*anterior apex:* unpaired, conspicuously or weakly developed, arising anteromesally, projected anterad, and usually convexly or subovally elongate, rarely sutriangular and widened anteriorly (Figs. 105, 110, 115), or bifurcated anteriorly (Fig. 69), or with anterolateral extensions (Fig. 183).

*lateral apex:* paired, arising sublaterally, conspicuously or weakly developed, usually convexly or triangularly elongate, and projected laterad.

*posterior apex:* unpaired, arising posteromesally, conspicuously or weakly developed, usually convexly elongate, and projected posterad.

#### Illustrations

Illustrations of the male genitalia were made using an Olympus BH-2 compound microscope equipped with a drawing tube. Male genitalia were examined and illustrated at 40X. For each species, lateral, dorsal, and ventral views of the male genitalia were illustrated, as well as a dorsal view of the apical segment of the inferior appendage and the phallic sclerites for almost all species. Sternum VII was illustrated only when its posterior margin had projections or processes. Illustrations of the wings of several species were made using an Olympus SZX12 stereomicroscope with a drawing tube. Forewing length was measured to the nearest 0.5 mm using a small hand held ruler. For illustrative purposes, the hind wings appear almost the same size as the forewings in the illustrations; however, in life the hind wings are shorter than the forewings. In the text the species are presented in alphabetical order, but the illustrations are grouped by similarity among the species to aid diagnosis and identification.

## Miscellaneous considerations

The diagnoses of the species and the identification key are based entirely on morphological characters of the male genitalia. To aid the non-specialist in identifying specimens in hand, the diagnoses and descriptions are presented in detail and comparatively structured, since the male genitalia are similar among the species. For simplicity, symmetrically paired structures are treated in the singular unless plural language is needed for clarity. Phallic sclerites are illustrated as they appeared in a representative specimen generally in a left lateral view, but their position and orientation in the retracted membrane are not fixed; they were drawn in such a way that their number and relative lengths could be seen. For this study, the Neotropical Region is considered to correspond to Mexico, the Lesser and Greater Antilles, and Central and South America.

The holotypes are deposited in the Instituto de Biología de la Universidad Nacional Autónoma de México (IBUNAM), the Illinois Natural History Survey, Champaign, IL (INHS), the University of Minnesota Insect Collection, St. Paul, MN (UMSP), and the National Museum of Natural History, Smithsonian Institution, Washington, DC (NMNH). Paratypes and other specimens are deposited in these institutions as well as in the Instituto Nacional de Biodiversidad, Costa Rica (INBio), Museo Entomológico de Antioquia, Colombia (MEA), Museo Entomológico de León, Nicaragua (MEL). Material was also examined from the California Academy of Sciences, San Francisco, CA, (CAS) and the Canadian National Collection, Ottawa, ON (CNC).

## Generic diagnosis

### *Wormaldia* McLachlan 1865

Type species: *Hydropsyche occipitalis* Pictet 1834, subsequent selection of Ross 1949, 154.

Diagnosis. From the other philopotamid genera known in the Neotropical Region, *Wormaldia* is distinguished by characters of the M vein of the forewing, the anal veins of the hind wing, and the shape of the inferior appendage. In Neotropical *Wormaldia* species, the forewing M vein is 4-branched ( $M_1$ ,  $M_2$ ,  $M_3$ , and  $M_4$ , Fig. 226)—some Nearctic species have the M vein 3-branched ( $M_1$ ,  $M_2$ , and  $M_{3+4}$ ); anal vein 2A of the hind wing is fused to 1A, resulting in 2A being atrophied beyond crossvein  $a_2$  (Fig. 227); and the inferior appendage is 2-segmented (Figs. 1, 3). In *Chimarra*, the forewing M vein is 3-branched ( $M_1$ ,  $M_2$ , and  $M_{3+4}$ ); anal vein 2A of the hind wing is upcurved and fused with vein 1A, resulting in a visible loop; and the inferior appendage is 1-segmented (see illustrations by Blahnik 1997, 1998, 2002; Flint 1998, Ross 1956). In *Chimarrhodelia*, the forewing M vein is 3-branched ( $M_1$ ,  $M_2$ , and  $M_{3+4}$ ); anal vein 2A of the hind wing is reduced to a short stub; and the inferior appendage is 1-segmented (see illustrations by Blahnik & Holzenthal 1992). In *Sortosa* and *Alterosa*, the forewing M vein is 4-branched; hind wing anal veins 1A, 2A, and 3A all reach the wing margin; and the inferior appendage is 2-segmented (see illustrations and discussion by Blahnik 2005).

Adult. Forewing length 4–8 mm. Body sclerites, including dorsum of head and thorax fuscous or brown, with small fuscous or brunneous setae. Head and palpi setose; antenna with lighter setae, annulated, shorter than forewing; scape stout, flagellum slender, usually in Neotropical species with small, brown and yellowish rings of small setae; ocelli present; maxillary palp with 5 segments, 1st and 2nd segments stout, subequal, 3rd segment longer and more slender than 1st and 2nd segments combined, 4th segment shorter than 3rd segment; 5th segment about as long as other segments combined, slender; labial palp shorter than maxillary palp, with 3 segments, 1st and 2nd segments short 3rd segment longer and slender. Leg segments with small, fuscous or brownish setae; tibial spur formula 2-4-4. Forewing (Fig. 226): fuscous or brunneous, covered with small, fine, fuscous or brown setae, sometimes with small, scattered patches of lighter setae, discoidal cell short, the M vein 3-branched ( $M_1$ ,  $M_2$ , and  $M_{3+4}$ , known species of the *W. thyria* Group) or 4-branched ( $M_1$ ,  $M_2$ ,  $M_3$ , and  $M_4$ , the remaining species of *Wormaldia*, Fig. 226); apical forks I, II, III, IV, and V usually present (fork I absent in *W. gabriella*, *W. lacerna*, *W. shawnee*, and *W. strotia*; fork IV absent in species of the *W. thyria* Group, see Muñoz-Quesada & Holzenthal, 2008). Hind wing (Fig. 227): shorter than forewing, discoidal cell short, apical forks I, II, III, and V usually present, R1 not fused to R2, anal vein 2A fused to 1A, resulting in 2A being atrophied beyond crossvein  $a_2$ .

Male. *Genitalia* (Figs. 1–6): Sternum VII with or without posteromesal projection or process. Tergum VIII usually straight anteriorly, diversely developed in form posteriorly; sternum VIII with or without posteromesal projection or process. Segment IX, when viewed dorsally, reduced to narrow, lightly sclerotized transverse band,



with anterior margin straight or concave, some Neotropical species with hook-shaped and anterodorsal projection (Figs. 7, 11, 18, 23, 28, 33); when viewed ventrally, straight or concave anteriorly, diversely developed in form posteriorly. Segment X, membranous, unilobate, usually triangular, projected posterad, parallel with superior appendages; varying from simple segment (Fig. 2) to complex segment of various lobate processes (Fig. 6). Superior appendage elongate, usually digitate. Inferior appendage 2-segmented; when viewed laterally, basal segment generally elongate, rectangular, wider and stouter than apical segment; when viewed ventrally, basal segments fused basally, bifurcated posteromesally into paired segments, bifurcation producing V-shaped or U-shaped emargination; apical segment generally elongate, with preapical or apical patch of short, black, spine-like setae on inner margin. Phallus, when viewed laterally, usually pistol-like, wide basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with small, internal, spine-like sclerites.

Female. *Genitalia*: Abdomen rounded, tapering from segment VII to segment XI. Abdominal segment VII longer than segments VIII–XI. Abdominal segments VII and VIII each with distinct sternum and tergum. Abdominal segment IX membranous, simple, shorter than tubular segment X. Abdominal segment XI small, tubular (Armitage 1996; Schmid 1982, figs. 156–161; 1998, figs. 114, 115).

Pupa, Larva, and Retreats. The immature stages and retreats of species of the genus *Wormaldia* from the Neotropical region have not been described. Muñoz-Quesada & Holzenthal (2008) provided brief descriptions, diagnoses, and bibliography of these stages for the Nearctic species.

## Species descriptions

### *Wormaldia alicia* Bueno-Soria, Santiago-Fragoso & Barba-Alvarez 2005

*Wormaldia alicia* Bueno-Soria, Santiago-Fragoso & Barba-Alvarez 2005, 482–483, fig. 5a, 5b, male, Mexico: Tabasco (CNIN [IBUNAM]).

This species was described after most of the types of the new and previously described species of *Wormaldia* included in this paper were examined and illustrated. We requested to borrow the type material of *W. alicia*, but it could not be located (Barba-Alvarez, personal communication). From the published illustrations of *W. alicia* (Bueno et al. 2005, figs. 5a, b), it is difficult to determine the true structure of some aspects of its morphology, especially the details of segment X and the phallus. Also, the posterior margins of sterna VII and VIII are said to be slightly produced, but these are not illustrated. The original diagnosis placed *W. alicia* in the *W. anilla* Group, with the species close to *W. endonima*, *W. dampfi*, *W. dorsata*, *W. isela*, new species, and *W. luma*, but differing in the morphology of the spines in the phallus. The teeth-like spines on the phallic sclerites are said to be unique compared to other species in the *W. anilla* Group. *Wormaldia alicia* is known from the type locality in the state of Tabasco, Mexico. The species is not included in the key presented below.

### *Wormaldia andrea* Muñoz-Quesada & Holzenthal, new species

Figures 109–113

Diagnosis. Among the known species of *Wormaldia*, this new species, together with *W. gallardoi*, new species, and *W. prolixa*, are discernible by the shapes of segment IX and tergum X. In these species, segment IX anteriorly has a conspicuous, elongate, and strongly acute projection (Figs. 104, 109, 114). In addition, the “head” of tergum X is convexly subtriangular and with its anterior apex subtriangularly widened (Figs. 105, 110, 115). Finally, the apical segment of the inferior appendage is noticeably longer than the basal segment (Figs. 104, 109, 114).

*Wormaldia andrea* is distinguished from the other 2 species by the following particular attributes: 1) tergum VIII with the posterior margin having 2 subtriangular and sublateral processes separated by a wide, deep, U-shaped emargination covered basomedially by a concave shelf with very tiny spines (Fig. 110); 2) tergum X having process “a” conspicuously lambda-shaped, with the outer lateral margins produced convexly at midlength, and strongly elongate, surpassing the middle of the tergum, and with process “b” triangular and slightly elongate (Fig. 110); and 3) the apical segment of the inferior appendage has its inner margin slightly twisted posteroventrally (Fig. 111).

**Description.** Adult: Length of male forewing 4.5–5.0 mm. Head light brown, with yellowish setae. Antenna long, slender, yellowish, with short, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 119); hind wing translucent, with few fine, small, brown setae, and with apical forks I, II, III, and V present (as in Fig. 120).

Male genitalia (Figs. 109–113): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected laterad, bearing 2 stout, subtriangular, posteromesal processes separated by deep, wide, U-shaped emargination covered basomedially by concave shelf with very tiny spines; when viewed laterally, posterior margin weakly concave and dorsally with subovate apex of posteromesal process. Sternum VIII with slight, convex posteromesal projection. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly triangular in appearance, with acute projection very strongly elongate anteriorly, weakly sinuous posteriorly; when viewed ventrally, concave anteriorly, slightly convex posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” conspicuously lambda-shaped, with outer lateral margins produced convexly at midlength, strongly elongate, surpassing middle of tergum; process “b” sublateral, triangular, slightly elongate, projected laterad; “head” wide, convexly triangular, with anterior apex subtriangularly widened, lateral apices subtriangularly projected, posterior apex wide, convex; when viewed laterally, slender, sinuous dorsally, concavely curved preapicodorsally, “head” subtriangularly elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate; when viewed laterally, stout, slightly tubularly elongate, shorter than segment X, weakly curved at midlength, widely rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, noticeably tubularly elongate, longer (about 1.3 times) and narrower than basal segment, subovally rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by shallow, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment stout, with inner ventral margin slightly twisted posteriorly, and bearing short, short, black, peg-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 113).

**Holotype:** Male. **ECUADOR: Tungurahua:** 13 km E Baños, [1° 23' S, 78° 25' W], el. 1550 m, 15.ix.1990, O. S. Flint, Jr. (in alcohol, NMNH).

**Paratypes:** **ECUADOR: Tungurahua:** 13 km E Baños, [1° 23' S, 78° 25' W], el. 1550 m, 15.ix.1990, O. S. Flint, Jr., 6 males, 3 females (4 males, 2 females in alcohol, NMNH; 2 males, 1 female in alcohol, UMSP).

**Etymology.** This new species is named in honor of Dr. Andrea Encalada of the Universidad San Francisco de Quito, as a gesture of thanks for her valuable cooperation and friendship, and in recognition of her devotion to the study and conservation of Ecuadorian aquatic ecosystems.

**Distribution.** ECUADOR: Tungurahua.

### ***Wormaldia anhelitus* Muñoz-Quesada & Holzenthal, new species**

Figures 255–259.

**Diagnosis.** This new species is related to *W. buenorum*, new species, and *W. planae*. These 3 species have tergum VIII with a U-shaped posteromesal emargination not covered by a shelf (Figs. 244, 249, 256). However, *W. anhelitus* can be distinguished from these 2 similar species and other members of *Wormaldia* by the shapes of tergum VIII and the inferior appendages.

In this new species, tergum VIII has 2 conspicuous and convex posteromesal projections (Fig. 256). When viewed laterally, the apical segment of the inferior appendage is thumb-shaped, concave at midlength, and ovoidly elongate posteriorly bearing an elongate and posterodorsal patch of short, black setae; when viewed dorsally, it is thick and with a conspicuous and rounded patch of setae (Figs. 255, 258).

**Description.** Adult: Length of male forewing 4.5–5.0 mm. Head brown, with yellowish setae. Antenna long, slender, light brown, with small, brown and yellowish rings of small setae. Maxillary palp yellowish, with brown



setae. Labial palp yellowish, with brown setae. Dorsum of thorax light brown. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, short, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 253); hind wing translucent, with few fine, small, brown setae, and with apical forks I, II, III, and V present (as in Fig. 255).

Male genitalia (Figs. 255–259): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 conspicuous, elongate, convex, posteromesal projections separated by broad, deep, U-shaped emargination; when viewed laterally, posterior margin slightly concave and dorsally having rounded posteromesal projection. Sternum VIII straight or very slightly convex posteromesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convex anteriorly, straight posteriorly; when viewed ventrally, concave anteriorly, nearly straight posteriorly with shallow mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, lambda-shaped, elongate, reaching middle of tergum; process “b” sublateral, obtusely triangular, elongate, projected laterad; “head” wide, triangular, with anterior apex conspicuous, wide, subovally elongate, lateral apices conspicuous, slender, subovally projected, posterior apex wide and rounded; when viewed laterally, dorsally convex at midlength, concavely curved preapicodorsally, “head” subovate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate; when viewed laterally, subovally elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, thumb-shaped, elongate, nearly equal in length, narrower than basal segment, concave at midlength, ovals elongate posteriorly bearing elongate posterodorsal patch of black, thin, short, spine-shaped setae; when viewed dorsally, apical segment thick, with conspicuous and rounded patch of setae; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by narrow, moderately deep, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin curved, apical segment stout, subovally widened posteriorly, bearing short, black setae apically. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 259).

**Holotype:** Male. **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 30.iii.–1.iv.1987, Holzenthal, Hamilton & Heyn (NMNH).

**Paratypes:** **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 30.iii.–1.iv.1987, Holzenthal, Hamilton & Heyn, 58 males, 2 females (in UMSP: 8 males, 2 females, in alcohol 43 males; in INBio: 2 males, in alcohol 5 males); **Guanacaste:** Parque Nacional Guanacaste, Estación Maritza, Río Tempisque, 10.958° N, 85.497° W, el. 550 m, ii.1994, Fdo. Muñoz-Q., 7 males (in alcohol, INBio); Área de Conservación Guanacaste (A.C.G.), Estación Pitilla, Río Orosí. 10.991° N, 85.428° W, el. 700 m, iii.1994, Fdo. Muñoz-Q., 6 males (in alcohol, INBio). **GUATEMALA: Suchitepéquez:** Suchitepéquez, [14° 25' N, 91° 20' W], Finca Moca, 12.vi.1966, Flint & Ortiz. 3 males, 1 female (NMNH). **NICARAGUA: Zelaya:** Cerro Saslaya, 13° 44' N, 85° 01' W, el. 700 m, iv.1996, J. M. Maes & J. Hernández, 4 males (in alcohol, NMNH); Río Latas, 14° 04' N, 88° 33' W, el. 220 m, 2.vi.1998, J. M. Maes & B. Hernández, 21 males, 2 females (in alcohol, MEL). **PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 5–11.x.1977, H. Wolda, 2 males (in alcohol, NMNH); same except, 16–29.xi.1977, H. Wolda, 8 males, 5 females (in alcohol, NMNH); 20.ix.–12.xii.1978, H. Wolda, 1 male (in alcohol, NMNH).

**Additional material examined:** **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 2–4.vii.1986, Holzenthal, Heyn & Armitage, 6 males, 7 females (UMSP); same except, 24–27.ii.1987, I. & A. Chacón, 5 males (UMSP); 13–16.vi.1988, C. M. & O. S. Flint, Jr. & Holzenthal, 35 males, 2 females (24 males, 1 female in alcohol, NMNH); 5–9.vii.1988, I. & A. Chacón, 1 male, 4 females (UMSP); 1–4.v.1990, Holzenthal & Blahnik, 83 males, 17 females (79 males, 16 females in alcohol UMSP); 28–30.vii.1990, Holzenthal, Blahnik & Muñoz, 57 males, 6 females (38 males, 2 females in alcohol UMSP); 6–10.iii.1991, Holzenthal, Muñoz & Huisman, 57 males, 12 females (46 males, 12 females in alcohol UMSP); Río Sarapiquí, carretera 2 km SE Cariblanco, 10.299° N, 84.172° W, el. 710 m, 22.vi.1986, Holzenthal, Heyn & Armitage, 1 male (in alcohol, UMSP); [Ciudad Quesada] Río Peje and falls, carretera 1 km SE San Vicente, 10.277° N, 84.388° W, el. 1450 m, 14–15.ii.1992, Holzenthal, Muñoz & Kjer, 1 male (in alcohol, UMSP); Cerro Campana, Río Bochinche and tribs., 6 km (air), NW Dos Ríos, 10.945° N, 85.413° W, el. 600 m, 22–23.vii.1987, Holzenthal, Morse & Clausen, 9 males (8 males in alcohol, UMSP); Quebrada Latas, 8.9 km NE Bajos

del Toro, 10.269° N, 84.260° W, el. 1030 m, 6.ix.1990, Holzenthal, Blahnik & Huisman, 1 male (in alcohol, UMSP); **Cartago:** Chitaría, [9° 57' N, 83° 36' W], 19.vi.1967, Flint & Ortiz, 1 male (NMNH); same except, Río Chitaría, route 10, 10 km NW Río Reventazón, 9.920° N, 83.604° W, el. 740 m, 21.iii.1991, Holzenthal, Kjer & Quesada, 3 males, 1 female (in alcohol, UMSP); Reserva Tapanti, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 9–10.v.1990, Holzenthal & Blahnik, 8 males (UMSP); same except, 10.ii.1994, Fdo. J. Muñoz-Q., 1 male (in alcohol, INBio); 10–13.ix.1991, Fdo. Muñoz-Q. & F. A. Quesada, 4 males, 4 females (INBio); unnamed trib., ca. 9 km (road) NW tunnel, 9.72° N, 83.78° W, el. 1400 m, 8–9.vi.1988, C. M. & O. S. Flint, Jr. & Holzenthal, 6 males, 2 females (1 male in alcohol, NMNH); Reserva Tapanti, Quebrada Palmitos and falls, 9.72° N, 83.78° W, el. 1400 m, 2–3.vi.1990, Holzenthal, Blahnik & Muñoz, 4 males (UMSP); same except, 1–2.viii.1990, Holzenthal, Blahnik & Muñoz, 9 males (UMSP); 23.viii.1990, Holzenthal & Huisman, 3 males (UMSP); Río Dos Amigos & falls, ca. 6 km (road) NW tunnel, 9.704° N, 83.783° W, el. 1500 m, 4–5.viii.1990, Holzenthal, Blahnik & Muñoz, 1 male (UMSP); Water fall ca. 1 km (road) NW tunnel, 9.69° N, 83.76° W, el. 1600 m, 24.iii.1991, Holzenthal, Muñoz & Huisman, 1 male (UMSP); **Guanacaste:** Quebrada García, 10.6 km ENE Quebrada Grande, 10.862° N, 85.248° W, el. 470 m, 8.iii.1986, Holzenthal & Fasth, 4 male, 1 female (in alcohol, UMSP), Parque Nacional Rincón de la Vieja, Río Negro, 10.765° N, 85.313° W, el. 810 m, 3.iii.1986, Holzenthal & Fasth, 1 male (UMSP); same except, Quebrada Zopilote, 10.765° N, 85.309° W, el. 785 m, 3.iii.1986, Holzenthal, 3 males, 10 females (in alcohol, UMSP); Parque Nacional Guanacaste, Estación Maritza, Río Tempisque, 10.958° N, 85.497° W, el. 550 m, 30–31.viii.1990, Huisman, Blahnik & Quesada, 1 male, 1 female (UMSP); Río Tempisque Sur, 10.95° N, 85.48° W, el. 600 m, 30.viii.1990, Huisman & Quesada, 1 male (in alcohol, UMSP); Río Aguacate, 0.5 km E. Aguacate (Laguna del Arenal), 10.565° N, 84.939° W, el. 590 m, 16.ii.1992, Holzenthal, Muñoz & Kjer, 1 male (in alcohol, UMSP); Zona Protectora Tenorio, tribs. to Río San Lorenzo, 6 km NW Tierras Morenas, 10.61° N, 84.96° W, el. 900 m, 17–19.ii.1992, Holzenthal, Muñoz & Kjer, 1 male (UMSP); **Heredia:** Parque Nacional Braulio Carrillo, Estación Magsasay, Río Peje, 10.402° N, 84.050° W, el. 130 m, 25–26.viii.1990, Holzenthal, Blahnik & Huisman, 1 male (in alcohol, UMSP); **Limón:** Parque Nacional Braulio Carrillo, Quebrada González, 10.160° N, 83.939° W, el. 480 m, 12–14.v.1990, Holzenthal & Blahnik, 6 males, 3 females (2 males, 2 females in alcohol UMSP); **Puntarenas:** Río Guineal, carretera 1 km (air) E. Finca Helechales, 9.076° N, 83.092° W, el. 840 m, 22.ii.1986, Holzenthal, Morse & Clausen, 1 male (in alcohol, UMSP); Jardín Botánico R. & C. Wilson, trib. along Sendero del Agua, 8.80° N, 82.96° W, el. 1180 m, 8.viii.1990, Holzenthal, Blahnik & Muñoz, 4 males, 3 females (in alcohol, UMSP); Río Jaba and rock quarry 1.4 km (air) W Las Cruces [San Vito de Jaba], 8.79° N, 82.97° W, el. 1150 m, 9.viii.1990, Holzenthal, Blahnik & Muñoz, 15 males, 16 females (UMSP); same except, 15.iii.1991, Holzenthal, Muñoz & Huisman, 4 males (in alcohol, UMSP); **San José:** Parque Nacional Braulio Carrillo, Quebrada Sanguijuela, 10.160° N, 83.963° W, el. 800 m, 11–12.vi.1988, C. M. & O. S. Flint, Jr. & A. Chacón, 1 male (NMNH); Quebrada Caraigres, 2.5 km (road) SW La Legua, 9.734° N, 84.120° W, el. 1470 m, 22.i.1992, Holzenthal, Kjer & Quesada, 7 males (1 male in alcohol UMSP); same except, Trib. to Quebrada Caraigres, 3.6 km (road) SW La Legua, 9.728° N, 84.125° W, el. 1650 m, 23.i.1992, Holzenthal, Kjer & Quesada, 1 male (INBio). **NICARAGUA:** **Jinotega:** Cerro Mazú, 14° 33' N., 85° 07' W, el. 220 m; 7–10.ix.1997, J. M. Maes & B. Hernández, 1 male (in alcohol, MEL); Área Protegida Datanli-El Diablo, La Quebradona, 1 km NE de Santa Maura, 13° 10.389' N, 85° 51.404' W, el. 1050 m, 29.vii.2000, Chamorro, Lacayo & Christensen, 10 males (in alcohol, MEL).

**Etymology:** *Anhelitus*, from the Latin for “out of breath” in reaction to the senior author's reaction upon completing this monograph.

**Distribution:** COSTA RICA: Alajuela, Cartago, Guanacaste, Heredia, Limón, Puntarenas, San José; GUATEMALA: Suchitepéquez; NICARAGUA: Jinotega, Zelaya; PANAMA: Chiriquí.

### ***Wormaldia araujoi* Muñoz-Quesada & Holzenthal, new species**

Figures 68–74.

**Diagnosis.** In this new species, tergum X has process “a” and the anterior apex of the “head” with distinctive shapes, by which it is easily distinguished from all known species of *Wormaldia*. Tergum X of this species has process “a” noticeably prominent and omega-shaped or ear-shaped, and the anterior apex of the “head” is conspicuously bifurcated anteromesally into subovate lobes projected anterolaterad (Fig. 69).

Description. Adult: Length of male forewing 3.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, light brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 73); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 74).

Male genitalia (Figs. 68–72): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with posterior margin projected posterad, produced mesally into 2 conspicuous, horn-shaped processes separated by wide, V-shaped emargination; when viewed laterally, posterodorsal corner with apex of posterior process. Sternum VIII with convex posteromesal projection, about 0.2 times length of sternum VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, lengthened ventrally, nearly trapezoid in appearance, convexly projected anteroventrad, slightly concave posteriorly; when viewed ventrally, sinuously concave anteriorly, weakly sinuous posteriorly with small, shallow concavity mesally. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, noticeably prominent, omega-shaped or ear-shaped, elongate, barely reaching middle of tergum; process “b” absent; “head” conspicuous, wide, with anterior apex clearly bifurcated medially into subovate lobes projected anterolaterad, lateral apices tiny and subtriangularly projected, posterior apex small, wide, rounded; when viewed laterally, slender, dorsally expanded at midlength, slightly curved preapicodorsally, “head” subtriangularly elongate with anterior lobe and lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, narrowly subovally pointed; when viewed laterally, tubularly elongate, nearly equal in length to segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangularly elongate, shorter (about 0.8 times) and narrower than basal segment, slightly concave and narrowest medially, slightly truncately widened posteriorly; when viewed dorsally, apical segment tubularly elongate, slightly subovally widened posteriorly, bearing rounded apical patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior 3/4ths, separated posteromesally by moderately deep, wide, U-shaped emargination, each basal segment stout, slightly wider at midlength, with outer margin convexly curved anteriorly, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 72).

**Holotype:** Male. **ECUADOR: Napo:** 5.2 km SW Pano, [1° 3' S, 77° 52' W], el. 640 m, 13.ix.v.1990, O. S. Flint, Jr. (NMNH).

**Etymology:** This new species is named in honor of Dr. Pablo Araujo of the Museo de Ciencias Naturales at Escuela Politécnica Nacional (Quito), as a gesture of thanks for his cooperation and friendship, and in recognition of his devotion to the study and conservation of Ecuadorian insects.

**Distribution:** ECUADOR: Napo.

### ***Wormaldia arizonensis* (Ling 1938)**

Figures 221–227.

*Dolophilus arizonensis* Ling 1938, 63, male, USA: Arizona (CAS); Ross 1941, 51.

*Wormaldia arizonensis* (Ling); Ross 1944, 292; 1949, 154–156, Pl. 13, figs. 2, 2A; 1956, 38, 40, 61, 62, figs. 20, 74 A, B; Denning 1956, 79; Fischer 1961, 46; 1971, 189; Bueno-Soria & Flint 1978, 194 (distribution); Armitage 1996 [work not paginated]; Muñoz-Quesada & Holzenthal 2008, 16, figs. 14–20, 129.

Diagnosis. At present, this species and *W. planae* are the only known species in the genus distributed in both the Nearctic and Neotropical regions (Muñoz-Quesada & Holzenthal 2008). Ross (1949, 1956) placed *W. arizonensis* in the *W. arizonensis* species Group.

Among the other recognized species in the genus, this species, as well as *W. navarroae*, new species, and *W. tarasca* are easily differentiated by several diagnostic features in combination: 1) process “a” of tergum X prominently lambda-shaped and conspicuously elongate, reaching the middle of tergum (Figs. 217, 222, 229); 2) the apex of segment X is large and conspicuously balloon or egg-shaped (Figs. 216, 217, 221, 222, 228, 229); and 3) when viewed laterally, the apical segment of the inferior appendage is triangular or subtriangular, as well as

noticeably narrower and shorter than the basal segment (Figs. 216, 221, 228). However, *W. arizonensis* can be distinguished from those similar species by the following distinctive aspects: 1) tergum VIII bearing 2 triangular and posteromesal projections separated by a wide and slightly concave mesal emargination, but without a concave and subdorsal shelf mesally (Fig. 222); 2) the superior appendage is strongly extended and convex mid-dorsally (Figs. 221); and 3) when viewed laterally, the apical segment of the inferior appendage is triangular, narrowly rounded posteriorly (Figs. 221).

Some specimens of this species show noticeable variation in the shape of the posterior elements of tergum VIII. The sublateral projections are smaller and the mesal emarginations shallower than those of the holotype.

**Description.** Adult: Length of male forewing 6.5–7.0 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 226; Ross 1956, fig. 20); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 227; Ross 1956, fig. 20).

**Male genitalia** (Figs. 221–225): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII concave anteriorly, slightly sinuous posterolaterally, with 2 stout, triangular, posteromesal projections separated by wide, concave, mesal emargination; when viewed laterally, posterodorsal corner with acute apex of posteromesal process. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, weakly concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convexly projected anterad, straight posteriorly; when viewed ventrally, concave anteriorly, weakly sinuous posteriorly with shallow mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, stout, with process “a” anteromedial, prominent, wide, lambda-shaped, elongate, barely reaching middle of tergum; processes “b” absent; apex distinctly broadly rounded; when viewed laterally, convexly extended mid-dorsally, narrow and slightly upcurved preapically, “head” prominently wide and balloon-shaped. Superior appendage, when viewed dorsally, parallel with segment X, convexly bulged at midlength, slightly pointed apically; when viewed laterally, thick, small, reaching middle of segment X, strongly extended convexly mid-dorsally, slightly pointed apically. Inferior appendage, 2-segmented; when viewed laterally, basal segment thick, subrectangular, elongate, noticeably widest and convex at midlength, apical segment stout, triangular, slightly elongate, shorter (about 0.7 times) and narrower than basal segment, rounded and narrowest posteriorly; when viewed dorsally, apical segment stout, with inner margin slightly sinuous, broadly rounded posteriorly, bearing an apical patch of short, black, spine-shaped, and peg-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with several visible, internal sclerites (Fig. 225).

**Material examined:** MEXICO: **Nuevo León:** Santiago, Potrero Redondo, [~ 25° 26' N, 100° 8' W], 1.v.1985, A. Contreras, 1 male (in alcohol, IBUNAM); same except, El Cercado, Arroyo Dolores, 20.v.1985, 1 male (in alcohol, IBUNAM); 9.vi.1985, 1 male (IBUNAM); Santiago, Las Adjuntas, [~ 25° 26' N, 100° 8' W], 7.xi.1985, A. Contreras & H. Rojas, 1 male (IBUNAM); **Oaxaca:** km 11 carr[etera] Teotitlán-Huautla, [18° 15' N, 97° 02' W], 6.xi.1988, R. Barba, 1 male (IBUNAM).

**Distribution:** MEXICO: Durango, Nuevo León (**new record**), Oaxaca (**new record**); USA: Arizona, Texas, Utah.

### ***Wormaldia aymara* Muñoz-Quesada & Holzenthal, new species**

Figures 80–84.

**Diagnosis.** This new species, *W. dachiardiorum*, new species, *W. inca*, new species, and *W. insignis* are distinctly different from other species because of the distinctive and conspicuously elongate projection posterodorsally on segment IX (best seen laterally, Figs. 75, 80, 85, 90); the character is not present in other known species of the genus. However, *W. aymara* can be readily distinguished from those 3 species by the characteristic shapes of terga VIII and X.



In this species, the posterior margin of tergum VIII has 2 conspicuous and bullhorn-shaped lateromesal processes (Fig. 81). In tergum X, process “a” is absent; and process “b” is prominent, semiovate, and strongly elongate (Fig. 81).

**Description.** Adult: Length of male forewing 5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 95); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 96).

**Male genitalia** (Figs. 80–84): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII having 2 stout, elongate, bullhorn-shaped, posteromesal processes; when viewed laterally, posterodorsal corner with ovate apex of posterior process. Sternum VIII with convex posteromesal projection, about 0.1 times length of sternum VIII. Segment IX, when viewed dorsally, slightly concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convexly projected anterad, posterior margin nearly straight, and having triangular and acutely elongate dorsal projection; when viewed ventrally, concave anteriorly, very weakly sinuous posteriorly, with mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” sublateral, conspicuously semiovate, strongly elongate, projected laterad; “head” small and flattened, with anterior apex tiny, narrow, subovally elongate, lateral and posterior apices united, consequently widely rounded posteriorly; when viewed laterally, slender, strongly concavely curved preapicodorsally, “head” hook-shaped. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, weakly incurved at midlength, rounded apically; when viewed laterally, very strongly elongate and tubular, nearly equal in length to segment X, slightly upcurved preapically, with apex directed posterodorsally. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex anteriorly, apical segment slender, subtriangularly elongate, shorter (about 0.8 times) and narrower than apical segment, narrowest and rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by wide, deep, U-shaped emargination, each basal segment, stout, widest at midlength, with outer margin convexly curved, apical segment tubularly elongate, narrowest and rounded posteriorly, with elongate and posteromedial patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 217).

**Holotype:** Male. **BOLIVIA: La Paz:** Yungas, Circuata to Cajuata, [16° 37' S, 67° 15' W], el. 2400 m, 3–5.xii.1984, L. E. Peña G. (NMNH).

**Etymology:** This new species is named in honor of the Aymara indigenous people, who inhabit the Andean region of Bolivia, Peru, and northern Chile.

**Distribution:** BOLIVIA: La Paz.

### ***Wormaldia barbai* Muñoz-Quesada & Holzenthal, new species**

Figures 172–176.

**Diagnosis.** This new species is easily identifiable by the singular shape and conspicuous size of 1 of its phallic sclerites, which is very distinctive compared to those of the other known species of *Wormaldia*. In this species, the phallic sclerite is noticeably sinuous and very long, about 1.1 times the length of segment VIII (Fig. 176).

**Description.** Adult: Length of male forewing 4.5–5.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 165); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 166).

**Male genitalia** (Figs. 172–176): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII having 2 conspicuous, stout, knob-shaped, posteromesal processes separated by broad, deep, U-shaped

emargination slightly covered basally by smooth shelf; when viewed laterally, posterodorsal corner with rounded apex of posteromesal process. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, slightly concave anteriorly; when viewed laterally, nearly subrectangular in appearance, convexly projected anterad, straight posteriorly; when viewed ventrally, sinuously concave anteriorly, weakly convex posteriorly with shallow mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, Y-shaped; strongly bifurcated and elongate, surpassing middle of tergum; process “b” sublateral, nearly obtusely subtriangular, elongate, projected laterad; “head” widely subtriangular and with anterior apex conspicuous and narrowly elongate, lateral apices narrow and convexly projected, posterior apex wide and rounded; when viewed laterally, dorsally convex at midlength, concavely curved preapicodorsally, “head” wide and subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate at midlength; when viewed laterally, tubularly elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, subrectangularly elongate, shorter (about 0.85 times) and narrower than basal segment, slightly concave and narrowest at midlength, subovally widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by narrow, deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment stout, subrectangularly elongate, slightly concave at midlength, subovally widened posteriorly, with apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites, one of them noticeably sinuous and very prominently long, about 1.1 times length of segment VIII (Fig. 176).

**Holotype:** Male. **MEXICO: Veracruz:** near Huatusco, [19° 9' N, 96° 57' W], 25–26.vii.1965, O. S. Flint, Jr. & Ortiz (NMNH).

**Paratypes:** **MEXICO: Michoacán:** Zurumucapio, [19° 26' N, 101° 52' W], 18.vii.1983, E. Barrera, 1 male (in alcohol, IBUNAM); same except, San Ángel Zurumucapio, a 3 km de Uruapan, [18° 28' N, 102° 00' W], 16.vii.1983, E. Barrera, M. García & A. Ibarra, 2 males, 2 females (in IBUNAM: in alcohol 1 male, 1 female; in UMSP: in alcohol 1 male, 1 female); **Oaxaca:** Pluma Hidalgo, Ruta 175, Oaxaca-Puerto Ángel, [16° 06' N, 96° 28' W], 27.xi.1985, H. Velasco, 1 male (in alcohol, IBUNAM); **Veracruz:** Barranca de Metlac, Ruta 150 Orizaba-Cordoba, [18° 54' N, 97° 00' W], 30.iii.1976, J. Bueno, 1 male (in alcohol, IBUNAM).

**Etymology:** This new species is named in honor of M. Sc. Rafael Barba of the Instituto de Biología at Universidad Nacional Autónoma de México (IBUNAM), as a gesture of thanks for his valuable cooperation and friendship.

**Distribution:** MEXICO: Michoacán, Oaxaca, Veracruz.

### ***Wormaldia bolivari* Muñoz-Quesada & Holzenthal, new species**

Figures 167–171.

**Diagnosis.** The structural appearance of tergum VIII and the inferior appendage in this new species, as well as in *W. savoriorum*, new species, and *W. zunigae*, new species, are similar and distinctive from the other known species of *Wormaldia*. They all have tergum VIII with a posteromesal shelf with its posterior margin concavely smooth (Figs. 168, 178, 183). In addition, the apical segment of the inferior appendage is noticeably shorter than the basal segment (Figs. 167, 177, 182). However, *W. bolivari* is distinguished from both those species by the following diagnostic combination of characteristics: 1) tergum VIII has 2 slight, convex posteromesal projections separated by a broad, moderately deep, concave emargination almost covered totally by a smooth, concave shelf (Fig. 168); 2) tergum X has process “a” conspicuous and nearly lambda-shaped, process “b” is medial and triangular, and the “head” is convexly subtriangular, with the anterior apex tiny and subovate (Fig. 168); and 3) the apical segment of the inferior appendage is widely rectangular, straight at midlength, and slightly truncated posteriorly (Fig. 167).

**Description.** Adult: Length of male forewing 4.5–5.0 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in



Fig. 165); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 166).

Male genitalia (Figs. 167–171): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII having 2 slight, convex, posteromesal projections separated by broad, moderately deep, concave emargination almost totally covered by smooth, concave shelf; when viewed laterally, posterodorsal corner with rounded apex of posteromesal projection. Sternum VIII with wide, convex, posteromesal projection, about 0.1 times length of sternum VIII. Segment IX, when viewed dorsally, slightly concave anteriorly; when viewed laterally, broad, rectangular in appearance, slightly convex anteriorly, concave posteriorly; when viewed ventrally, weakly concave anteriorly, sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, conspicuous, nearly lambda-shaped; process “b” sublateral, conspicuously triangular, projected laterad; “head” convexly subtriangular and with anterior apex tiny, narrow, subovate, lateral apices small and convexly projected, posterior apex wide and rounded; when viewed laterally, slightly extended dorsally, concavely curved preapicodorsally, “head” wide and rounded. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, tubular; when viewed laterally, subovally elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment thick, subrectangular, elongate, broadest and convex at midlength, apical segment stout, slightly rectangularly elongate, shorter (about 0.75 times) and narrower than basal segment, truncated and narrowest posteriorly; when viewed dorsally, apical segment as in ventral view; basal segments fused, united for about their anterior 3/5ths, separated posteromesally by narrow, moderately deep, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved anteriorly, apical segment stout, tubularly elongate, weakly roundly widened posteriorly, with rounded and apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 171).

**Holotype:** Male. **VENEZUELA: Barinas:** 22 km NW Barinitas, [8° 45' N, 70° 25' W], 24.ii.1976, C.M. & O.S. Flint, Jr. (NMNH).

**Paratypes:** **VENEZUELA: Barinas:** 22 km NW Barinitas, [8° 45' N, 70° 25' W], 24.ii.1976, C. M. & O. S. Flint, Jr., 1 female (NMNH); **Lara:** Yacambu National Park, 13 km SE Sanare, [9° 41' N, 69° 31' W], el. ~ 1450 m, 4–7.iii.1978, J. B. Heppener, 1 male, 3 females (in alcohol, NMNH).

**Etymology:** This new species is named in honor of the Latin American General Simón Bolívar (1783–1830), who is called “*El Gran Libertador*” (The Great Liberator).

**Distribution:** VENEZUELA: Barinas, Lara.

### ***Wormaldia boteroi* Muñoz-Quesada & Holzenthal, new species**

Figures 148–154.

**Diagnosis.** This species is similar to *Wormaldia eberhardi*, new species. They are easily distinguished from the other known species of *Wormaldia* by the unusual shape of the apical segment of the inferior appendage, which is prominent, nearly quadrate, slightly concave at midlength, truncately widened posteriorly, and equal or wider than the basal segment (best seen laterally, Figs. 148, 155). In spite of this similarity, *W. boteroi* differs from *W. eberhardi* by the following distinctive features: 1) tergum VIII having a concave mesal shelf with many spines (Fig. 149); 2) tergum X with process “b” developed into slight, convex bulge, and the “head” prominent and balloon-shaped (Fig. 149); and 3) apical segment of the inferior appendage, when viewed dorsolaterally, thick, widely rounded posteriorly, with the inner margin relatively straight and bearing a widely rounded apicolateral patch of short setae (Fig. 151).

**Description.** Adult: Length of male forewing 3.5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 153); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 154).

Male genitalia (Figs. 148–152): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with posterior sublateral margin widely and convexly produced and having 2 mesal elements consisting of prominent, wide, deep, U-shaped emargination covered basomedially by concave shelf with many tiny spines; when viewed laterally, posterior margin weakly concave and slightly convexly produced dorsally. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, convexly projected anterad, very weakly concave posteriorly; when viewed ventrally, concave anteriorly, convex posteriorly with shallow mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a”, conspicuous, lambda-shaped, elongate, barely reaching middle of tergum; process “b” sublateral, weakly developed into slight, convex bulge; “head” prominent, with apices united and producing noticeable balloon appearance; when viewed laterally, slender, dorsally weak and convex at midlength, strongly concave and curved preapicodorsally, “head” narrowly elongate and nearly hook-shaped. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender and curved basally, stout in posterior half, rounded apically; when viewed laterally, elongate, shorter than segment X, sinuously upcurved at midlength, straight and stout in posterior half. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment thick, nearly quadrate, nearly equal in width and shorter (about 0.6 times) than basal segment, slightly concave at midlength, truncately widened posteriorly; when viewed dorsolaterally, apical segment thick, widely rounded, bearing widely rounded, apicolateral patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by wide, moderately deep, U-shaped emargination, each basal segment thick, slightly wider at midlength, with outer margin weakly convexly curved, apical segment thick and widely rounded posteriorly. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 152).

**Holotype:** Male. **COLOMBIA: Valle del Cauca:** Río Raposo, [3° 43' N, 77° 8' W], viii.1965, V. H. Lee (in alcohol, NMNH).

**Etymology:** This new species is named in honor of the Colombian painter and sculptor Dr. Fernando Botero (born in Medellín, 1932), in recognition of his outstanding artwork. The widened inferior appendages of the male genitalia of this new species, remind us of the fat or inflated forms of the characters of Dr. Botero.

**Distribution:** COLOMBIA: Valle del Cauca.

### ***Wormaldia buenorum* Muñoz-Quesada & Holzenthal, new species**

Figures 243–247.

**Diagnosis.** This new species structurally resembles *W. anhelitus*, and *W. planae*, in having tergum VIII with a U-shaped and posteromesal emargination not covered by a shelf (Figs. 244, 249, 256). However, *W. buenorum* differs from those species and other known species in the genus in the shapes of tergum VIII and the inferior appendage. In this species, tergum VIII has 2 conspicuous and acutely triangular processes posteromesally (Fig. 244). When viewed laterally, the apical segment of the inferior appendage is subrectangular, slightly concave at midlength, and slightly subovally produced posteroventrally; when viewed dorsally, it is truncate posteriorly and bears a weakly concave apical patch of short, black setae (Figs. 243, 246).

**Description.** Adult: Length of male forewing 3.5–4.0 mm (holotype: 6 mm, in alcohol). Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 253); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 254).

**Male genitalia** (Figs. 243–247): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 stout, acutely triangular, posteromesal processes separated by broad, deep, U-shaped emargination; when viewed laterally, posterior margin weakly sinuous, dorsally with rounded apex of posteromesal process evident. Sternum VIII straight posteriorly, without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, narrowest dorsally, nearly triangular in appearance, convexly projected anterad, very weakly sinuous posteriorly; when viewed ventrally, weakly concave

anteriorly, very weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, Y-shaped, extremely elongate, surpassing middle of tergum; process “b” sublateral, conspicuous, obtusely triangular, elongate, projected laterad; “head” subtriangular, with anterior apex wide, subovally elongate, lateral apices wide, slightly convexly projected, posterior margin wide, roundly elongate; when viewed laterally, dorsally convex at midlength, concavely curved preapicodorsally, “head” subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stoutly subovate posteriorly; when viewed laterally, nearly tubularly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, nearly tubularly elongate, shorter (about 0.7 times) and narrower than basal segment, slightly concave and narrowest at midlength, slightly subovally produced posteroventrally; when viewed dorsally, apical segment elongate, slightly widened posteriorly, with truncate, apical patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by narrow, deep, U-shaped emargination, each basal segment stout, slightly widest at midlength, with outer margin convexly curved anteriorly, apical segment stout, subrectangularly elongate, slightly incurved at midlength, truncated and slightly widened posteriorly. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 247).

**Holotype:** Male. **MEXICO: Chiapas:** Finca Vergel, 19.v.1935, A. Dampf (in alcohol, MF 4208, INHS).

**Paratypes:** **MEXICO: Chiapas:** Finca Vergel, 25.v.1935, A. Dampf, 1 male (in alcohol, MF 4288, INHS); same except, 12.vi.1935, A. Dampf, 1 male (in alcohol, MF 4530, INHS).

**Etymology:** This new species is named in honor of Dr. Joaquín Bueno-Soria (Instituto de Biología at Universidad Nacional Autónoma de México, IBUNAM) and his family, as a gesture of thanks for his appreciable and kind friendship and cooperation, and in recognition of his many contributions to the study of the Neotropical Trichoptera.

**Distribution:** MEXICO: Chiapas.

### ***Wormaldia calderonae* Muñoz-Quesada & Holzenthal, new species**

Figures 206–210.

**Diagnosis.** This new species shares with *W. menchuae*, new species, and *W. trondi*, new species, a tergum VIII having the posterior margin of the posteromesal shelf produced concavely sublaterally and possessing 2 conspicuous, elongate, horn-like or digitate processes (Figs. 193, 207, 212), which are distinctive features useful in separating these species from the known species of *Wormaldia*. These 3 closely related species can be distinguished by the shapes of terga VIII and X.

In this new species, tergum VIII has 2 stout, convexly subtriangular, posteromesal projections followed by a shelf with 2 conspicuous, slender, bullhorn-shaped processes separated by a wide and shallow emargination (Fig. 207). Tergum X has process “a” conspicuously lambda-shaped, with the “head” subtriangular and noticeably wide, and with its anterior apex small and narrow (Fig. 207). Distinctive aspects of the other 2 species are detailed their respective diagnoses.

**Description.** Adult: Length of male forewing 4.5 mm (holotype: 6 mm, in alcohol). Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 197); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 198).

**Male genitalia** (Figs. 206–210): Sternum VII straight posteriorly, without mesal projection or process. Tergum VIII slightly projected laterad, with 2 conspicuous, convexly subtriangular, posteromesal projections separated by deep, broad, U-shaped emargination slightly covered basally by shelf with 2 conspicuous, slender, bullhorn-shaped processes separated by wide, shallow emargination; when viewed laterally, posterodorsal corner with apices of posterior projection and process evident. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly rectangular in

appearance, convex anteriorly, concave posteriorly; when viewed ventrally, slightly concave anteriorly, convexly projected posterad, with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, lambda-shaped, elongate, reaching lower middle of tergum; process “b” sublateral, conspicuous, convexly triangular, elongate, projected laterad; “head” wide, convexly subtriangular, with anterior apex small, elongate and narrow, lateral apices conspicuous, triangularly projected, posterior apex small, wide, rounded; when viewed laterally, dorsally convex at midlength, concavely curved preapicodorsally, “head” wide, subovate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, acutely narrow posteriorly; when viewed laterally, stout, subovally elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, subrectangularly elongate, shorter (about 0.9 times) and narrower than basal segment, weakly concave on ventral edge, widely rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by wide, deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment tubularly elongate, subovate posteriorly, with apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 210).

**Holotype:** Male. **MEXICO: Chiapas:** El Aguacero, Ruta 190 Tuxtla Gutiérrez-Ocosocuautila a 15 km, [16° 4' N, 93° 33' W], 16.ix.1982, J. Padilla (in alcohol, IBUNAM).

**Paratypes:** **MEXICO: Chiapas:** El Aguacero, Ruta 190 Tuxtla Gutiérrez-Ocosocuautila a 15 km, [16° 4' N, 93° 33' W], 16.ix.1982, J. Padilla, 4 males, 2 females (in IBUNAM: in alcohol 2 males, 2 females; in NMNH: in alcohol 1 male; in UMSP: in alcohol 1 male); same except, Palenque, [17° 29' N, 92° 00' W], 19.v.1984, A. Ibarra, 1 male (in alcohol, IBUNAM).

**Etymology:** This new species is named in honor of M. Sc. Jaquelina Beatriz Calderón Arreola of the Facultad de Biología at Universidad Michoacana de San Nicolás de Hidalgo (Morelia, México), as a gesture of thanks for her cooperation and friendship, and in recognition of her devotion to the study and conservation of Mexican insects.

**Distribution:** MEXICO: Chiapas.

### ***Wormaldia chrismark* Muñoz-Quesada & Holzenthal, new species**

Figures 49–53.

**Diagnosis.** This new species is very closely related to *W. flinti*, new species. The position and shape of the patch of small setae on the apical segment of the inferior appendage in these 2 species is very distinctive within the genus *Wormaldia*. Both species are differentiated from the other known members in the genus by the following distinctive features in combination: 1) the patch of setae on the apical segment of the inferior appendage is ovate and located preapicomeresally on the inner margin and not reaching the apical margin of the apical segment (best seen laterally, Figs. 49, 54); 2) the outer lateral shape of the inferior appendage is shaped as in Figs. 49, 54; and 3) tergum X has process “a” absent. In spite of these similarities, *W. chrismark* can be separated from *W. flinti* by the respective shapes of tergum X and the inferior appendage.

In this new species, tergum X has process “b” weakly developed into a tiny, pointed projection, and the “head” has its anterior apex tiny and semicircular; when viewed laterally, the anterior apex of the “head” is very finely serrated posterodorsally (Figs. 49–50). When viewed ventrally, the apical segment of the inferior appendage is clearly thick, nearly rectangularly elongate, and truncately widened posteriorly, bearing a conspicuous ovate, preapical patch of setae (Fig. 51).

**Description.** Adult: Length of male forewing 4.5–5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 59); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 60).



Male genitalia (Figs. 49–53): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly sinuously projected posterad, with shallow, mesal concavity; when viewed laterally, posterior margin very weakly concave. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, slender and more or less subrectangular in appearance, convexly projected anterad, very weakly sinuous posteriorly; when viewed ventrally, concave anteriorly, weakly convex posteriorly, with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” sublateral, weakly developed into tiny, pointed projection; “head” flattened, with anterior apex tiny, semicircular, lateral apices tiny, weakly convexly projected, posterior apex tiny, convex; when viewed laterally, slender, preapicodorsally very finely serrated, concavely curved, “head” nearly subtriangular in shape. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, rounded apically; when viewed laterally, elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment broad, slightly elongate, widest and convex at midlength, apical segment stout, subrectangular, tubularly elongate, narrower, but equal in length, to basal segment, slightly concave and narrowest at midlength, subovally widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/4ths, separated posteromesally by shallow, wide, U-shaped emargination, each basal segment thick, wider in posterior half, with outer margin convexly curved, apical segment thick, rectangularly elongate, slightly incurved at midlength, slightly truncately widened posteriorly, with prominent, ovate, apicomeral patch of short, thin, black, small, spine-shaped setae not reaching apicolateral margin of outer posterior corner. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 53).

**Holotype:** Male. **PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 14–20.ix.1977, H. Wolda (in alcohol, NMNH).

**Paratypes:** **PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 14–20.ix.1977, H. Wolda, 1 male (in alcohol, UMSP); same except, 26.x.–15.xi.1977, H. Wolda, 2 males, 3 females (in alcohol, NMNH); 5.–18.x.1977, H. Wolda, 2 males (in alcohol, NMNH); 30.xi.–13.xii.1977, H. Wolda, 9 males (in alcohol, NMNH); 20.ix.–12.xii.1978, H. Wolda, 4 males (in alcohol, UMSP); 10.i.–20.ii.1979, H. Wolda, 3 males (in alcohol, NMNH); 30.v.–26.vi.1979, H. Wolda, 2 males (in alcohol, NMNH).

**Etymology:** This new species is named in honor of Christina M. and Mark M. Haddad, very special Minnesotan friends of the senior author, as a gesture of his gratitude for their cooperation and friendship.

**Distribution:** PANAMA: Chiriqui.

### ***Wormaldia contrerasi* Muñoz-Quesada & Holzenthal, new species**

Figures 131–135.

**Diagnosis.** This new species is closely related to *W. francovilla*, new species, *W. imberti*, new species, and *W. machadorum*, new species. These new species are easily distinguished from the other known members of *Wormaldia* by a combination of distinctive features of segments IX and X. The anterior margin of segment IX is strongly acutely projected (best seen laterally, Figs. 121, 126, 131, 136). Tergum X is slender, tubular, and prominently elongate (at least 1.5 times the length of the superior appendage, Figs. 121, 122, 126, 127, 131, 132, 136, 137). However, *W. contrerasi* can be distinguished by having the posterior margin of tergum VIII very weakly sinuous and without a processes mesally (Fig. 132). Also in this species, tergum X has process “a” prominent and nearly circular (Fig. 132). The apical segment of the inferior appendage, in lateral view, is triangular and noticeably shorter than the basal segment (Fig. 131).

**Description.** Adult: Length of male forewing 4 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 141); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 142).

Male genitalia (Figs. 131–135): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with posterior margin projected slightly sinuously and without mesal processes; when viewed laterally,

posterodorsal corner very weakly projected convexly. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly triangular in appearance, anterior margin with very strong, slender projection acutely elongate, posterior margin straight; when viewed ventrally, strongly concave anteriorly, slightly convex posteriorly with mesal concavity. Segment X, when viewed dorsally, strongly subtriangularly elongate, with process “a” anteromesal, conspicuous, nearly circular, wide, elongate, reaching lower middle of tergum; process “b” lateral on lower middle, conspicuous, semioval, elongate, projected laterad; “head” slender, small, subovate; when viewed laterally, dorsally slightly expanded at midlength, shallowly sinuous dorsally, tubular and noticeably slender posteriorly, “head” stick shaped, narrowly rounded. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, rounded apically; when viewed laterally, slightly tubularly elongate, reaching middle of segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest at midlength, convex dorsally, straight ventrally, apical segment stout, triangular, shorter (about 0.8 times) and narrower than basal segment, acutely rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, wide, V-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment tubular elongate, narrowest and rounded posteriorly, with short, black, small, peg-shaped setae scattered posteroventrally on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, sclerotized, internal process (Fig. 135).

**Holotype:** Male. **PANAMA: Panama:** Cerro Campana, [8° 40' 60" N, 79° 55' W], 11–14.vii.1967, O. S. Flint, Jr. (NMNH).

**Paratypes:** **PANAMA: Panama:** Barro Colorado Island, [9° 8' 59" N, 79° 50' 59" W], 26.x.–1.xi.1988, H. Wolda, 1 male (in alcohol, NMNH); same except, Snyder-Molino Trail, 16–22.i.1991, H. Wolda, 1 male (in alcohol, UMSP).

**Etymology:** This new species is named in honor of Dr. Atilano Contreras Ramos of the Universidad Nacional Autónoma de México as a gesture of thanks for his valuable cooperation and friendship, and in recognition of his many contributions to the study of the Neotropical Megaloptera.

**Distribution:** PANAMA: Panama.

### ***Wormaldia cornuta* Bueno-Soria & Holzenthal 1986**

Figures 238–242.

*Wormaldia cornuta* Bueno-Soria & Holzenthal 1986, 138, figs. 1–3, male, México: Chiapas (NMNH).

**Diagnosis.** This species was placed in the *W. arizonensis* Group of Ross (1949, 1956) by Bueno-Soria & Holzenthal (1986). This species is distinctively different from the other known species of *Wormaldia* in the singular shapes of terga VIII and X. Tergum VIII has 2 prominent, strongly elongate, stout, bull-horn-shaped, posteromesal processes, these separated by a wide, deep, and U-shaped emargination (Fig. 239). Tergum X has a prominent process “a” that is nearly U-shaped and narrowed posteriorly, and a prominent, acutely triangular process “b” (Fig. 239).

**Description.** Adult: Length of male forewing 4 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present; hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present.

**Male genitalia** (Figs. 238–242): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 prominent, strongly elongate, bull-horn-shaped, posteromesal processes, these separated by deep, wide, U-shaped emargination; when viewed laterally, posterodorsal corner with weakly downcurved, pointed apex of posteromesal process. Sternum VIII straight or very slightly convex posteromesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, approximately subrectangular in appearance, convexly projected anterad, weakly sinuous posteriorly; when viewed ventrally,



slightly concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, prominent, nearly U-shaped, narrowed posteriorly, elongate, reaching lower middle of tergum; process “b” sublateral, acutely triangular, elongate, projected anterolaterad; “head” subtriangular, with anterior apex narrow, slightly, subovally elongate, lateral apices wide, subtriangularly projected laterad, posterior apex small, widely rounded; when viewed laterally, dorsally sinuously bulged at midlength, concavely curved preapicodorsally, “head” subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender; when viewed laterally, ovally elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, subrectangular, tubularly elongate, nearly equal in length, narrower than basal segment, slightly concave, narrowest at midlength, roundly widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, narrow, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment elongate tubularly, subovate posteriorly, with elongate, apicolateral patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 242).

**Material examined: MEXICO: Chiapas:** Tributario del Río Teapa, sobre ruta la Méx. 195, a 3 kms al norte de Ixhuatán, [ $\sim 7^{\circ} 17' 31''$  N,  $93^{\circ} 0' 28''$  W], 23.xii.1983, S. Hamilton, R. Holzenthal & J. Kovach, 1 male (Holotype, NMNH).

**Distribution:** MEXICO: Chiapas.

### ***Wormaldia dachiardiorum* Muñoz-Quesada & Holzenthal, new species**

Figures 75–79.

**Diagnosis.** This new species resembles *W. aymara*, new species, *W. inca*, new species, and *W. insignis*, in having a conspicuous and strongly elongate projection posterodorsally on segment IX (best seen laterally, Figs. 75, 80, 85, 90), which is not present in the other known species of the genus. In spite of this conspicuous similarity, *W. dachiardiorum* is easily separated from those 3 species by the distinctive shapes of its terga VIII and X. In this new species, tergum VIII has a noticeable mesodorsal invagination surrounding a conspicuous, narrow, U-shaped, posteromesal emargination (Fig. 76). Tergum X has process “a” conspicuously triangular, narrow, and strongly elongate (Fig. 76).

**Description.** Adult: Length of male forewing 6.5–7.0 mm. Head brown, with lighter setae. Antenna long, slender, brown, with small, brown and yellowish rings of small setae. Maxillary palps brown, with brown setae. Labial palps light brown, with brown setae. Dorsum of thorax light brown. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 95); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 96).

**Male genitalia** (Figs. 75–79): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII having strong, mesodorsal invagination surrounding conspicuous, narrow, deep, U-shaped, posteromesal emargination; when viewed laterally, posterodorsal corner rounded. Sternum VIII with convex, posteromesal projection, less than 0.2 times length of sternum VIII. Segment IX, when viewed dorsally, slightly concave anteriorly; when viewed laterally, broad, nearly rectangular in appearance, convex anteriorly, posterior margin concave, with strong, acutely elongate, dorsal projection; when viewed ventrally, slightly concave anteriorly, slightly convex posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuously triangular, narrow, strongly elongate, reaching middle of tergum; processes “b” sublateral, nearly subovate, elongate, convexly projected laterad; “head” convexly subtriangular, with anterior apex wide, semicircular, lateral apices wide, convexly projected, posterior apex small, rounded; when viewed laterally, convexly bulged anteriorly, slender at midlength, concavely curved preapicodorsally, “head” wide, semicircular apically, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded apically; when viewed laterally, strongly tubularly elongate, slightly shorter than segment X, rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal

segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangularly elongate, shorter (about 0.8 times) and narrower than apical segment, weakly concave and narrowest at midlength, widely rounded posteriorly; when viewed dorsally, apical segment as in ventral view, when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by moderately deep, U-shaped emargination, each basal segment stout, slightly widest at midlength, with outer margin convexly curved, apical segment stout, subrectangularly elongate, subovally widened posteriorly, with elongate, apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 79).

**Holotype:** Male. **COLOMBIA: Magdalena:** Parque Nacional Sierra Nevada de Santa Marta, Estación Experimental San Lorenzo, Quebrada Segunda, 11° 61' 46" N, 74° 38' W, el. 2100 m, 11.xii.1997, Fdo. Muñoz *et al.* (NMNH).

**Paratype:** **COLOMBIA: Magdalena:** Parque Nacional Sierra Nevada de Santa Marta, Estación Experimental San Lorenzo, Quebrada Segunda, 11° 61' 46" N, 74° 38' W, el. 2100 m, 11.xii.1997, Fdo. Muñoz *et al.*, 1 male (MEA).

**Etymology:** This new species is named in honor of the Colombian family D'Achiardi-Návas, friends of the senior author, as a gesture of his gratitude for their friendship, encouragement, and cooperation.

**Distribution:** COLOMBIA: Magdalena.

### ***Wormaldia dampfi* Ross & King 1956**

Figures 38–41.

*Wormaldia dampfi* Ross & King, in Ross 1956, 61, 62, figs. 72 A–B, 122 A–B, 128, male, Mexico: Chiapas (INHS); Bueno-Soria and Flint 1978, 194 (distribution).

**Diagnosis.** This species was placed in the *W. arizonensis* Group by Ross (1949, 1956). In *W. dampfi*, segment X has a distinctive shape apically, which easily distinguishes this species from the other species of *Wormaldia*. Segment X is very strongly curved preapically, with a conspicuous hook-shape, which is projected anteriorly (Fig. 38).

**Description.** Adult: Length of male forewing 4–6 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps brown, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, and with small patch of light setae over cord and crossvein *m-cu*, with apical forks I, II, III, IV, and V present (as in Fig. 47); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 48).

**Male genitalia** (Figs. 38–41): Sternum VII with broad, convex, posteromesal projection slightly elongate, about 0.3 times length of sternum VIII. Tergum VIII with posterior margin slightly straight or slightly concave; when viewed laterally, margins relatively straight. Sternum VIII slightly convexly projected posteromesad. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, with strong, convex projection anteriorly, very weakly sinuous posteriorly; when viewed ventrally, concave anteriorly, weakly convex posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, strongly subtriangularly elongate, weakly concave at midlength, some specimens show very tiny spines mesally, bulged preapically, narrowly rounded apically, with mesoapical projection triangularly elongate, directed anteriorly, process “a” absent; process “b” absent; when viewed laterally, stout, very strongly curved preapically, slender, pointed, hook-shaped apically, directed anteriorly. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded apically; when viewed laterally, strongly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment broad, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, tubularly elongate, relatively equal in length, narrower than basal segment, weakly concave and narrowest at midlength, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by deep, broad, V-shaped emargination, each basal segment stout, slightly widest at midlength, with outer margin convexly curved anteriorly, apical segment, slender, tubularly elongate, rounded posteriorly, with ovate, apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically,

very lightly sclerotized, with highly convoluted membranous section with several internal sclerites, difficult to distinguish.

**Material examined:** **MEXICO: Chiapas:** Finca Germania, 20.vi.1935, A. Dampf, 1 male (in alcohol, Paratype, # MF 4571, INHS); same except, San Cristóbal, 9.iii.1938, A. Dampf, 1 male (in alcohol, Holotype, MF # 6480, INHS-Trichoptera # 22265); Tapachula, Monteperla Unión Juárez, [15° 06' N, 92° 10' W], 18.iii.1985, Vertiz. H. Velasco, 1 male (in alcohol, IBUNAM); **Nuevo León:** Santiago, Las Adjuntas, [~ 25° 26' N, 100° 8' W], 3.xi.1985, A. Contreras, 1 male (IBUNAM); **Oaxaca:** km 11 carr[etera] Teotitlán-Huautla, [18° 15' N, 97° 02' W], 6.xi.1988, R. Barba, 1 male (IBUNAM). **NICARAGUA: Jinotega:** Cerro Kilambe, 13° 34' N, 85° 43' W, el. 1520 m, viii.1997, J. M. Maes & J. Hernández, 7 males, 3 females (in alcohol, MEL); Peñas Blancas, 13° 17' N, 85° 33' W, 1300 m, 25.vii.1997, J. M. Maes & J. Hernández, 6 males, 4 females (in MEL: in alcohol 2 males, 4 males; in NMNH: in alcohol 2 males; in UMSP: in alcohol 2 males).

**Distribution:** MEXICO: Chiapas, Nuevo León (**new record**), Oaxaca (**new record**); NICARAGUA (**new record**): Jinotega.

### ***Wormaldia dorsata* Ross & King 1956**

Figures 11–17.

*Wormaldia dorsata* Ross & King, in Ross 1956, 62, figs. 70 A–B, 131, male, Mexico: Chiapas (INHS); Bueno-Soria & Flint 1978, 194 (distribution).

**Diagnosis.** This species was placed in the *W. anilla* Group by Ross (1956). It is close to *W. fredycarol*, new species, *W. isela*, new species, *W. luma*, *W. maesi*, new species, and *W. palma*. All can be distinguished from the other known species in the genus by a combination of distinctive features of segments IX and X. In these species, segment IX has a nearly hook-shaped projection anterodorsally (best seen laterally, Figs. 7, 11, 18, 23, 28, 33). The structural appearance of segment X is also very characteristic in these species. Tergum X is stout and nearly triangular, without process “a” and with the “head” wide, rounded posteriorly, and without lateral apices (Figs. 8, 12, 19, 24, 29, 34). *Wormaldia dorsata* is distinctly recognizable from the other species by the combination of the following 2 features: 1) tergum VIII with a moderately deep and concave emargination posteromesally, and without a conspicuous, subdorsomesal pouch (Fig. 12); and 2) tergum X is triangularly elongate, having no processes, and with the “head” narrowed and rounded; when viewed laterally, the “head” is tubularly narrow and rounded (Fig. 11–12).

**Description.** Adult: Length of male forewing 5.5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax light brown. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 16); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 17).

**Male genitalia** (Figs. 11–15): Sternum VII with broad, convex, posteromesal projection, about 0.2 times length of sternum VIII. Tergum VIII with moderately deep, wide, concave emargination posteromesally; when viewed laterally, margins straight. Sternum VIII straight or very weakly convex posteromesally. Segment IX, when viewed dorsally, with anterior margin deeply concave having subovate, mesal enlargement; when viewed laterally, broad, nearly triangular in appearance, with slender, hook-shaped projection anterodorsally, with wide, convex, strongly elongate projection anteriorly, sinuous posteriorly; when viewed ventrally, concave anteriorly, nearly straight posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, clearly triangularly elongate, bulged at midlength, narrowed, rounded posteriorly, without processes “a” and “b”; when viewed laterally, slender, tubularly elongate, “head” narrowly rounded. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, slightly sinuous, rounded apically; when viewed laterally, stout, strongly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, tubularly elongate, nearly equal in length, narrower than basal segment, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by moderately deep, U-shaped emargination, each basal segment stout, widest at midlength, with

outer margin convexly curved, apical segment tubularly elongate, slightly narrowest and rounded posteriorly, with short, thin, black, spine-shaped setae scattered on mesal surface and in elongate, apicolateral patch on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 15).

**Material examined: MEXICO: Chiapas:** Finca Vergel, 19.v.1935, A Dampf, 1 male (in alcohol, Holotype, MF 4205, INHS-Trichoptera 22266).

Distribution: MEXICO: Chiapas, Oaxaca.

### ***Wormaldia eberhardi* Muñoz-Quesada & Holzenthal, new species**

Figures 155–159.

Diagnosis. Within the genus *Wormaldia*, this new species and *W. boteroi* are easily recognized by the unusual shape of the apical segment of the inferior appendage, which is prominent, nearly quadrate, slightly concave mesally, truncately widened posteriorly, and equal to or broader than the basal segment (best seen laterally, Figs. 148, 155). *Wormaldia eberhardi* differs from *W. boteroi* in the shapes of terga VIII and X, as well as in the apical segment of the inferior appendage. In *W. eberhardi*, the posterior margin of tergum VIII bears 2 short, digitate, sublateral processes followed by a concave, smooth shelf (Fig. 156). Additionally, tergum X has process “b” obtusely triangular, and the “head” has a subtriangular appearance (Fig. 156). When viewed dorsolaterally, the apical segment of the inferior appendage has an elongate, nearly 8-shaped, apical patch of short setae, with the inner margin concave (Fig. 158).

Description. Adult: Length of male forewing 4 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 153); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 154).

Male genitalia (Figs. 155–159): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII having 2 conspicuous, elongate, knob-shaped processes separated by deep, U-shaped, mesal emargination, which is covered basomedially by smooth, concave shelf; when viewed laterally, posterodorsal corner with subovate apex of posterior process. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, slender, nearly subrectangular in appearance, convexly projected anterad, very weakly sinuous posteriorly; when viewed ventrally, slightly concave anteriorly, weakly convex posteriorly with tiny concavity mesally. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, lambda-shaped, wide, elongate, reaching middle of tergum; process “b” sublateral, obtusely triangular, projected laterad; “head” subtriangular, with anterior apex small, subovally elongate, lateral apices small, subtriangularly projected, posterior apex widely rounded; when viewed laterally, slender, convex mid-dorsally, strongly curved preapicodorsally, “head” wide, semiovate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout; when viewed laterally, subovally elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, weakly broad and convex at midlength, apical segment thick, nearly quadrate, shorter (about 0.7 times) and broader than basal segment, slightly concave at midlength, truncately widened posteriorly; when viewed dorsolaterally, apical segment with nearly 8-shaped, apical patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by moderately deep, wide, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved; apical segment subrectangular, with inner margin concave at midlength, truncately widened posteriorly, with narrow, apical patch of short, black setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 159).

**Holotype:** Male. **PANAMA: Panama:** Canal Zone, Gamboa, Pipeline Rd., [9° 7' N, 79° 43' W], vii.1967, W. W. Wirth (NMNH).



**Paratypes: PANAMA: Panama:** Canal Zone, Gamboa, Pipeline Rd., [9° 7' N, 79° 43' W], vii.1967, W. W. Wirth, 2 males (1 male in NMNH; 1 male in UMSP).

**Etymology:** This new species is named in honor of Dr. William G. Eberhard of the Escuela de Biología at Universidad de Costa Rica (Costa Rica), as a gesture of thanks for his appreciable encouragement and friendship to the senior author, and in recognition of his numerous outstanding contributions to the study of the Neotropical biology.

**Distribution:** PANAMA: Panama.

### ***Wormaldia endonima* Ross & King 1956**

Figures 42–48.

*Wormaldia endonima* Ross & King, in Ross 1956, 61, 62, figs. 71 A-B, 127, male, Mexico: Chiapas (INHS); Bueno-Soria and Flint 1978, 194 (distribution).

**Diagnosis.** This species was placed in the *W. anilla* Group by Ross (1956) and has been reported only from the southern Mexico. Tergum X of this species has a distinctive shape, which resembles those of the Nearctic species, but it can be easily distinguished from the known species from both the Nearctic and Neotropical regions by various other characteristics in combination.

From Neotropical species, it differs by the simple triangular structure of tergum X, which does not have processes “a” and “b”, and with the “head” only having its posterior apex narrowly rounded. Specifically, from the Nearctic members of the *W. anilla* Group (Armitage 1996, Muñoz-Quesada & Holzenthal 2008, Ross 1956), *W. endonima* differs by several features in combination: 1) tergum VIII has the posterior margin slightly straight or with a wide and very shallow concavity mesally (Fig. 43); 2) sternum IX is without a posteromesal process (Fig. 44); 3) tergum X is triangular, slender, elongate, and rounded apically (Fig. 43); and 4) by the shape of the inferior appendage (Fig. 42).

**Description.** Adult: Length of male forewing 4.5–5.0 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 47); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 48).

**Male genitalia** (Figs. 42–46): Sternum VII with wide, subtriangular, convexly elongate, posteromesal process, about 0.4 times length of sternum VIII. Tergum VIII with wide, very shallow concavity posteromesally; when viewed laterally, margins straight. Sternum VIII with slight, convex, posteromesal projection, smaller than posteromesal process of sternum VII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, slender, nearly subrectangular in appearance, convexly projected anterad, very weakly sinuous posteriorly; when viewed ventrally, concave anteriorly, convexly projected posterad with shallow, mesal concavity. Segment X, when viewed dorsally, nearly triangularly elongate, with posterior apex narrowly rounded, processes “a” and “b” absent; when viewed laterally, with dorsal margin straight, narrow, rounded apically. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded posteriorly; when viewed laterally, slightly elongate, shorter than segment X, weakly bulged at midlength. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, strongly tubularly elongate, longer (about 1.2 times) and narrower than basal segment, wide, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/5ths, separated posteromesally by deep and V-shaped emargination, basal segments stout, slightly widest at midlength, with outer margin convexly curved, apical segment slender, tubularly elongate, subovate posteriorly, with inner margin bearing scattered short, thin, black, spine-shaped setae on mesal surface and in elongate, apicolateral patch. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with various visible, internal sclerites (Fig. 46).

**Material examined: MEXICO: Chiapas:** Finca Maravillas, 16.xii.1931, A. Dampf, 2 males, 1 female (in alcohol, Paratype, # MF 2196, INHS); same except, Finca Germania, 20.vi.1935, A. Dampf, 1 male (in alcohol,

Holotype, # MF 4571, INHS-Trichoptera 22267); Finca Esperanza, 20.vi.1938, A. Dampf, 1 male (in alcohol, Paratype, # MF 6931, INHS).

**Distribution:** MEXICO: Chiapas.

### ***Wormaldia esperonis* Ross & King 1956**

Figures 61–67.

*Wormaldia esperonis* Ross & King, in Ross 1956, 61, 63, figs. 76 A–B, 124 A–B, 129, male, Mexico: Chiapas (INHS); Bueno-Soria and Flint 1978, 194 (distribution).

**Diagnosis.** This species was placed in the *W. arizonensis* Group by Ross (1949, 1956). At present, *W. esperonis* is unique within *Wormaldia* in that tergum VIII possesses 3 small, subdorsal processes posteromesally (Fig. 62). Also, the shape of the apical segment of the inferior appendage in ventral view, which is triangularly elongate at midlength and with the inner margin straight posteriorly (Fig. 63), helps to distinguish it from the other species of *Wormaldia*.

**Description.** Adult: Length of male forewing 5 mm (holotype: 6 mm, in alcohol). Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 66); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 67).

**Male genitalia** (Figs. 61–65): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII convexly projected posterad, slightly straight mesally, having 3 small, tubercular, subdorsal processes posteromesally; when viewed laterally, posterior margin slightly concave, dorsally with apices of subdorsal processes. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly C-shaped in appearance, convexly projected anterad, roughly sinuously concave posteriorly; when viewed ventrally, slightly concave anteriorly, weakly convexly projected posterad with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, Y-shaped, deeply bifurcated, strongly elongate, reaching middle of tergum; process “b” sublateral, conspicuous, triangular, projected laterad; “head” wide, with anterior apex nearly rectangular, weakly convex anteriorly, lateral apices small, convexly projected, posterior apex small, rounded; when viewed laterally, slender, concavely curved preapicodorsally, “head” wide, subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, bulged at midlength, narrowly pointed posteriorly; when viewed laterally, slightly elongate, shorter than segment X, subovally elongate. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment slender, rectangular, tubularly elongate, relatively equal in length, narrower than basal segment, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, V-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment triangularly elongate, with inner margin straight posteriorly, bearing an elongate, lateral patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 65).

**Material examined:** MEXICO: Chiapas: Finca Esperanza, 6–12.ii.1939, A. Dampf, 1 male (in alcohol, Holotype, # MF 8676, INHS-Trichoptera 22268); same except, 1 male (in alcohol, Paratype, # MF 4709, INHS).

**Distribution:** MEXICO: Chiapas.

### ***Wormaldia flinti* Muñoz-Quesada & Holzenthal, new species**

Figures 54–60.

**Diagnosis.** This new species and *W. chrismark* are very similar. Both species have a patch of small setae on the



apical segment of the inferior appendage with a distinctive shape and position, by which they can be differentiated from all other known species of *Wormaldia*. The patch of setae in these 2 species is ovate and located preapicomesally on the inner margin, not reaching the apical margin of the apical segment (best seen laterally, Figs. 49, 54). Tergum X has the process “a” absent. In addition, in both species the lateral appearance of the inferior appendage is very similar (Figs. 49, 54). This new species differs from *W. chrismark* in the shapes of tergum X and the inferior appendage.

In *W. flinti*, tergum X has process “b” appearing as a slender, subovate band, and the “head” has its anterior apex conspicuously and ovally widened; when viewed laterally, it is smooth posterodorsally (Figs. 54–55). When viewed ventrally, the apical segment of the inferior appendage is tubularly elongate, narrower and subovate posteriorly, having a small, ovate, preapical patch of setae (Figs. 56).

**Description.** Adult: Length of male forewing 4.5–5.5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 59); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 60).

**Male genitalia** (Figs. 54–58): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII sinuously projected posterad with wide, shallow concavity mesally; when viewed laterally, posterior margin concave, with dorsal apex convexly projected. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convexly projected anteriorly, nearly straight posteriorly; when viewed ventrally, concave anteriorly, very weakly convex posteriorly with very shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” sublateral, developed into narrow, ovally elongate band; “head” subovate, slightly elongate, with anterior apex conspicuous, ovally widened, lateral apices united to rounded, wide posterior apex; when viewed laterally, slender, preapicodorsally smooth, very weakly concavely curved, “head” ovally elongate. Superior appendage digitate; when viewed dorsally, parallel with segment X, bulged at midlength, rounded apically; when viewed laterally, elongately bulged at midlength, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment slender, subrectangular, tubularly elongate, relatively equal in length, narrower than basal segment, slightly concave at midlength, slightly roundly widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by moderately deep, wide, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment stout, tubularly elongate, subovate posteriorly, with small, ovate, preapicomesal patch of short, thin, black, small, spine-shaped setae not reaching apicolateral margin of outer posterior corner. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 58).

**Holotype:** Male. **PANAMA: Chiriqui:** Guadalupe Arriba, 8° 52' 26" N, 82° 33' 13" W, 22–28.ii.1984, H. Wolda (in alcohol, NMNH).

**Paratypes:** **BOLIVIA: La Paz:** Coroico, [16° 10' S, 67° 44' W], el. 2200 m, 23–24.xi.1984, L. E. Peña G, 1 male, 4 females (in alcohol, NMNH). **PANAMA: Chiriqui:** Guadalupe Arriba, 8° 52' 26" N, 82° 33' 13" W, 1–26.i.1984, H. Wolda, 2 males, 2 females (in alcohol, NMNH); same except, 28.iii.–3.iv.1984, H. Wolda, 1 male (in alcohol, NMNH); 28.iii.–3.iv.1984, H. Wolda, 1 male (in alcohol, UMSP); 26.ix.–30.x.1984, H. Wolda, 1 male, 6 females (in alcohol, NMNH); 3–30.vii.1985, H. Wolda, 1 male, 2 females (in alcohol, UMSP); 21–27.viii.1985, H. Wolda, 1 male, 1 female (in alcohol, NMNH).

**Etymology:** This new species is named in honor of Dr. Oliver S. Flint, Jr., of the Smithsonian Institution, Washington, DC, as a gesture of thanks for his valuable collaboration, encouragement, and friendship, and in recognition of his numerous outstanding contributions to the study of the Neotropical Trichoptera.

**Distribution:** BOLIVIA: La Paz; PANAMA: Chiriqui.

### ***Wormaldia francovilla* Muñoz-Quesada & Holzenthal, new species**

Figures 121–125.

Diagnosis. Among the known species of *Wormaldia*, this new species, *W. contrerasi*, *W. imberti*, new species, and *W. machadorum*, new species, are distinctively characterized by the following combination of features: 1) the anterior margin of segment IX is strongly acutely projected (best seen laterally, Figs. 121, 126, 131, 136); and 2) tergum X is slender, tubular, and prominently elongate (at least 1.5 times the length of the superior appendage, Figs. 121, 122, 126, 127, 131, 132, 136, 137). *Wormaldia francovilla* can be distinguished from these 3 species by the shapes of terga VIII and X, and the inferior appendage. In *W. francovilla*, the posterior margin of tergum VIII has a conspicuous, deep, U-shaped emargination mesally, covered partially by a semicircular shelf (Fig. 122). Tergum X has process “a” conspicuously rounded (Fig. 122). The inferior appendage has a slender, thumb-shaped apical segment slightly downcurved at midlength and slightly longer than the basal segment (Fig. 121).

Description. Adult: Length of male forewing 3.5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 141); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 142).

Male genitalia (Figs. 121–125): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII convexly projected posterad, having deep, U-shaped, posteromesal emargination covered basomedially by semicircular shelf; when viewed laterally, posterior margin concave. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, subtriangular in appearance, anterior margin with wide, convex, strongly elongate projection, posterior margin very weakly concave posteriorly; when viewed ventrally, deeply concave anteriorly, sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, strongly subtriangularly elongate, with process “a” anteromesal, conspicuous, nearly circular; process “b” sublateral, narrow, elongate, very finely and weakly sinuously projected laterad; “head” subtriangularly widened, flattened, with anterior apex very tiny, semicircular, lateral apices small, triangularly projected, posterior apex small, rounded; when viewed laterally, convexly extended anteriorly, slender, tubular at midlength, slightly concavely curved preapicodorsally, “head” tiny, semicircular. Superior appendage digitate; when viewed dorsally, nearly parallel with segment X, slender, rounded apically; when viewed laterally, slightly elongate, shorter than segment X, slightly upcurved at midlength, rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest at midlength, convex dorsally, straight ventrally, apical segment stout, thumb-shaped, slightly downcurved at midlength, strongly elongate, longer (about 1.1 times) and narrower than basal segment; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by deep, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment tubularly elongate, slightly incurved at midlength, rounded posteriorly, with elongate, posteromedial patch of short, thin, black, small, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 125).

**Holotype:** Male. **PANAMA: Panama:** Barro Colorado Island, [9° 8' 59" N, 79° 50' 59" W], 7–13.xii.1988, H. Wolda (in alcohol, NMNH).

**Etymology:** This new species is named in honor of the family Franco-Villalobos (Héctor, Magdalena, Maguita, and Sofia), as a gesture of gratitude for their friendship and cooperation during the senior author's student days in Minnesota.

**Distribution:** PANAMA: Panama.

### ***Wormaldia fredycarol* Muñoz-Quesada & Holzenthal, new species**

Figures 18–22.

Diagnosis. This new species, *W. dorsata*, *W. isela*, new species, *W. luma*, *W. maesi*, new species, and *W. palma*, are easily distinguished from the other known species of *Wormaldia* by a combination of several distinctive attributes

of segments IX and X. In these 6 species, segment IX has a nearly hook-shaped projection anterodorsally (best seen laterally, Figs. 7, 11, 18, 23, 28, 33). Tergum X is stout and nearly triangular, without process “a”, and with the “head” wide, rounded posteriorly, and without lateral apices (Figs. 8, 12, 19, 24, 29, 34). Despite these similarities, *W. fredycarol* can be distinguished from the other 5 species by the shapes of terga VIII and X. In *W. fredycarol*, tergum VIII has a wide, deep concavity posteriorly, and lacks a conspicuous, subdorsal pouch mesally (Fig. 19). Tergum X is triangularly elongate, with process “b” developed into a very weak, convex bulge, and the “head” is conspicuous and widely rounded; when viewed laterally, the “head” is wide and semicircular (Figs. 18–19).

**Description.** Adult: Length of male forewing 6.0–6.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, and with small patch of lighter setae over cord and crossveins *m-cu* and *cu*, with apical forks I, II, III, IV, and V present (as in Fig. 16); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 17).

**Male genitalia** (Figs. 18–22): Sternum VII with broad, convex, posteromesal projection, less than 0.2 times length of sternum VIII. Tergum VIII with anterior margin slightly concave, posterior margin with conspicuous, wide, deep mesal concavity; when viewed laterally, posterodorsal corner rounded. Sternum VIII with posterior margin straight or weakly convex mesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, with small, hook-shaped projection anterodorsally, convexly projected anterad, slightly sinuous posteriorly; when viewed ventrally, weakly concave anteriorly, sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, clearly triangularly elongate, with process “a” absent; process “b” sublateral, developed into very weak, convex bulge with tiny spines; “head” conspicuous, widely subcircular, with anterior apex slightly suboval; when viewed laterally, sinuous dorsally, weakly upcurved preapicodorsally, “head” noticeably wide, balloon-shaped. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded apically; when viewed laterally, tubularly elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment thick, subrectangularly elongate, broadest and convex at midlength; apical segment stout, rectangularly elongate, shorter (about 0.8 times) and narrower than basal segment, truncately rounded, narrowest posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/4ths, separated posteromesally by moderately deep, wide, V-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment stout, tubularly elongate, weakly incurved at midlength, slightly truncately rounded posteriorly, with apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 22).

**Holotype:** Male. **COSTA RICA: San José:** Trib. to Quebrada Caraigres, 3.6 km (road) SW La Legua, 9.728° N, 84.125° W, el. 1650 m, 23.i.1992, Holzenthal, Kjer & Quesada, 1 male (UMSP).

**Paratypes:** **COSTA RICA: Cartago:** Reserva Tapanti, water fall ca. 1 km (road) NW tunnel, 9.69° N, 83.76° W, 2–3.viii.1990, el. 1600 m, Holzenthal, Blahnik & Muñoz, 2 males (UMSP); **San José:** Trib. to Quebrada Caraigres, 3.6 km (road) SW La Legua, 9.728° N, 84.125° W, el. 1650 m, 23.i.1992, Holzenthal, Kjer & Quesada, 7 males (2 males in INBio; 2 males in NMNH; 3 males in UMSP). **PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 3–9.vii.1985, H. Wolda, 1 male (in alcohol, NMNH).

**Etymology:** This new species is named in honor of Freddy A. Quesada and Carolina Cano parataxonomists of the Área de Conservación Guanacaste, Costa Rica, as a gesture of thanks and in recognition of their valuable cooperation with the study of the Costa Rican Trichoptera and their friendship.

**Distribution:** COSTA RICA: Cartago, San José; PANAMA: Chiriqui.

### ***Wormaldia gallardoi* Muñoz-Quesada & Holzenthal, new species** Figures 104–108.

**Diagnosis.** This new species shares with *W. andrea* and *W. proluxa* similar structural features of segments IX and X, as well as in the inferior appendage, rendering them easily recognizable from the other known species of *Wormaldia*. In these species, segment IX has a conspicuous, elongate, and strongly acute projection anteriorly (Figs. 104, 109, 114). In addition, the “head” of tergum X is convexly subtriangular and its anterior apex is

subtriangularly widened (Figs. 105, 110, 115). Finally, the apical segment of the inferior appendage is noticeably longer than the basal segment (Figs. 104, 109, 114). In spite of these similarities, *W. gallardoi* can be distinguished from those 2 species by the shapes of terga VIII and X. In this new species, tergum VIII has the posterior margin with 2 prominent, convex, sublateral projections followed by 2 narrowly elongate, curved apically, subdorsal projections and separated by a deep, U-shaped emargination, itself slightly covered basally by a concave shelf (Fig. 105). Additionally, tergum X in *W. gallardoi*, has process “a” inverted, U-shaped and weakly elongate, and process “b” obtusely triangular and noticeably elongate (Fig. 105).

All the material examined from Costa Rica and Panama of this new species had formerly been identified as *W. prolixa* (Flint 1991, Flint *et al.* 1999). Consequently, the distribution of *W. prolixa* is now restricted to Colombia.

**Description.** Adult: Length of male forewing 4.5–5.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 119); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 120).

**Male genitalia** (Figs. 104–108): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 prominent, widely convex, posteromesal projections followed by 2 narrow, elongate, subdorsal projections curved and pointed posteroapically, these 4 former elements separated by wide, deep, U-shaped emargination with very tiny spines in its lateral margins and slightly covered by concave shelf; when viewed laterally, posterior margin slightly concave, dorsally spiny, bearing subovate apex of posterosubdorsal projection. Sternum VIII with wide, convex projection posteromesally, about 0.3 times length of sternum VIII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly triangular in appearance, with wide, convex projection very strongly elongate anteriorly, straight posteriorly; when viewed ventrally, strongly concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, conspicuous, inverted U-shaped, narrow, slightly elongate; process “b” sublateral, obtusely triangular, elongate, projected laterad; “head” wide, convexly triangular, with anterior apex subtriangularly widened, lateral apices subtriangularly projected, posterior apex wide, convex; when viewed laterally, slender, sinuous mid-dorsally, concavely curved preapicodorsally, “head” subtriangular, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, sinuously ovate; when viewed laterally, stout, tubularly elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, visibly tubularly elongate, longer (about 1.3 times) and narrower than basal segment, subovally rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by moderately deep, V-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment nearly subtubularly elongate, with inner margin slightly concave bearing short, black, small, spine- and peg-shaped setae ventrally on mesal surface. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 108).

**Holotype:** Male. **COSTA RICA: Guanacaste:** Parque Nacional Guanacaste, Río San Josecito, 10.922° N, 85.470° W, el. 960 m, 3–4.iv.1987, Holzenthal, Hamilton & Heyn (UMSP).

**Paratypes:** **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 30.iii.–1.iv.1987, Holzenthal, Hamilton & Heyn, 13 males, 5 females (12 males, 5 females in alcohol, UMSP); [Ciudad Quesada] Río Peje and falls, carretera 1 km SE San Vicente, 10.277° N, 84.388° W, el. 1450 m, 14–15.ii.1992, Holzenthal, Muñoz & Kjer, 8 males (7 males in alcohol, UMSP); **Cartago:** Reserva Tapanti, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 10–13.ix.1991, Fdo. Muñoz-Q. & F. A. Quesada, 3 males (INBio); **Guanacaste:** Parque Nacional Guanacaste, Río San Josecito, 10.922° N, 85.470° W, el. 960 m, 3–4.iv.1987, Holzenthal, Hamilton & Heyn, 4 males (in INBio: 2 males; in NMNH: 1 male; in UMSP: 1 male); Zona Protectora Tenorio, tribs. to Río San Lorenzo, 6 km NW Tierras Morenas, 10.61° N, 84.96° W, el. 900 m, 17–19.ii.1992, Holzenthal, Muñoz & Kjer, 2 males (INBio); **San José:** Trib. to Quebrada Caraigres, 3.6 km (road) SW La Legua, 9.728° N, 84.125° W, el. 1650 m, 23.i.1992, Holzenthal, Kjer & Quesada, 4 males (NMNH). **PANAMA: Chiriquí:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W,



el. 1050 m, 21.ix–25.x.1977, H. Wolda, 15 males, 1 female (in alcohol, NMNH); same except, 11.v.–19.vii.1978, H. Wolda, 10 males, 5 females (in UMSP: 3 males, 2 females in alcohol; in INBio: 3 males in alcohol; in NMNH: 4 males, 3 females in alcohol); 30.v.–10.vii.1979, H. Wolda, 10 males, 5 females (in alcohol, NMNH).

**Additional material examined: COSTA RICA: Alajuela:** Río La Paz Pequeña, 7.8 km N Vara Blanca, 10.211° N, 84.116° W, el. 1230 m, 13.ii.1986, Holzenthal, Morse, Fasth, 3 males, 1 female (UMSP); Río La Paz, route 9, 7.6 km N Vara Blanca, 10.208° N, 84.166° W, el. 1340 m, 13.ii.1986, Morse, 1 male, 4 females (UMSP); Parque Nacional Rincón de la Vieja, Quebrada Zopilote, 10.769° N, 85.281° W, el. 810 m, 4.iii.1986, Holzenthal & Fasth, 3 males, 2 females (in alcohol, UMSP); Cerro Campana, ca. 6 km (air) NW Dos Ríos, 10.9° N, 85.4° W, el. 640 m, 15–16.iii.1986, Holzenthal & Fasth, 2 males (UMSP); same except, Río Bochinche and tribs., 6 km (air), NW Dos Ríos, 10.945° N, 85.413° W, el. 600 m, 22–23.vii.1987, Holzenthal, Morse & Clausen, 2 males, 1 female (1 male, 1 female in alcohol, UMSP); Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 2–4.vii.1986, Holzenthal, Heyn & Armitage, 2 males (UMSP); same except, 24–27.ii.1987, I. & A. Chacón, 9 males (2 males in INBio; 7 males in UMSP); 1–4.v.1990, Holzenthal & Blahnik, 14 males, 6 females (6 males in alcohol, UMSP); 6–10.iii.1991, Holzenthal, Muñoz & Huisman, 14 males (13 males in alcohol, UMSP); Quebrada Virgencita, 10.2 km S Bajos del Toro, 10.168° N, 84.326° W, el. 1780 m, 5–6.ix.1990, Holzenthal, Blahnik & Huisman, 1 male, 3 females (UMSP); same except, 10.ii.1992, Holzenthal, Muñoz & Kjer, 1 male (UMSP); **Cartago:** Reserva Tapanti, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 9–10.v.1990, Holzenthal & Blahnik, 2 males (UMSP); same except, 10.ii.1994, Fdo. Muñoz-Q., 7 males (in alcohol, INBio); same except, unnamed trib., ca. 9 km (road) NW tunnel, 9.72° N, 83.78° W, el. 1400 m, 8–9.vi.1988, C. M. & O. S. Flint, Jr. & Holzenthal, 1 male (UMSP); Quebrada Palmitos and falls, 9.72° N, 83.78° W, el. 1400 m, 1–2.viii.1990, Holzenthal, Blahnik & Muñoz, 4 males (UMSP); 23.viii.1990, Holzenthal & Huisman, 1 male, 1 female (UMSP); 24–25.iii.1991, Holzenthal, Muñoz & Huisman, 1 male (UMSP); **Guanacaste:** Parque Nacional Rincón de la Vieja, Quebrada Zopilote, 10.765° N, 85.309° W, el. 785 m, 3.iii.1986, Holzenthal, 5 males (in alcohol, UMSP); Parque Nacional Guanacaste, Estación Maritza, Río Tempisque, 10.958° N, 85.497° W, el. 550 m, ii.1994, Fdo. Muñoz-Q., 1 male (in alcohol, INBio); same except, Río Tempisque Sur, 10.95° N, 85.48° W, el. 600 m, 30.viii.1990, Huisman & Quesada, 3 males, 3 females (in alcohol, UMSP); **Limón:** 16 km W Guápiles, [10° 13' N, 83° 47' W], el. 400 m, ii–iii.1989, Paul Hanson, 1 male, 1 female (in alcohol, UMSP); Parque Nacional Braulio Carrillo, Quebrada González, 10.160° N, 83.939° W, el. 480 m, 12–14.v.1990, Holzenthal & Blahnik, 1 male (UMSP); **Puntarenas:** Río Bellavista, 1.5 km NW Las Alturas, 8.951° N, 82.846° W, el. 1400 m, 18.ii.1986, Holzenthal, Morse & Fasth, 2 males (UMSP); same except, 15–17.vi.1986, Holzenthal, Heyn & Armitage, 5 males (UMSP); 2–3.viii.1987, Holzenthal, Morse & Clausen, 1 male, 1 female (UMSP); 10–11.viii.1990, Holzenthal, Blahnik & Muñoz, 2 males, 1 female (UMSP); 16–17.viii.1991, Holzenthal, Muñoz & Huisman, 2 males (in alcohol, UMSP); Trib. to Río Bellavista in Las Alturas (road to quarry), 8.952° N, 82.848° W, el. 1480 m, 13–14.viii.1990, Holzenthal, Blahnik & Muñoz, 1 male (UMSP); Río Cotón in Las Alturas, 8.938° N, 82.826° W, el. 1360 m, 12.viii.1990, Holzenthal, Blahnik & Muñoz, 1 male (in alcohol, UMSP); same except, small spring seep to Río Cotón in Las Alturas, 8.939° N, 82.824° W, el. 1380 m, 14.viii.1990, Holzenthal, Blahnik & Muñoz, 1 male, 1 female (in alcohol, UMSP); Río Jaba and rock quarry 1.4 km (air) W Las Cruces [San Vito de Jaba], 8.79° N, 82.97° W, el. 1150 m, 15.iii.1991, Holzenthal, Muñoz & Huisman, 3 males (2 males in alcohol UMSP); Jardín Botánico R. & C. Wilson, trib. along Sendero del Agua, 8.80° N, 82.96° W, el. 1180 m, 8.viii.1990, Holzenthal, Blahnik & Muñoz, 6 males, 3 females (in alcohol, UMSP); Río Guineal, carretera 1 km (air) E. Finca Helechales, 9.076° N, 83.092° W, el. 840 m, 22.ii.1986, Holzenthal, Morse & Clausen, 1 male (in alcohol, UMSP); Quebrada Tusa, route 2, 3.5 km S El Brujo, 9.064° N, 83.274° W, el. 180 m, 21.ii.1986, Holzenthal, Morse & Fasth, 1 male (in alcohol, UMSP); **San José:** Parque Nacional Braulio Carrillo, park head quarters, 10.059° N, 84.107° W, el. 1650 m, 7.vii.1986, Holzenthal, Heyn & Armitage, 1 male (in alcohol, UMSP); same except, Estación Carrillo, Quebrada Sanguijuela, 10.160° N, 83.963° W, el. 800, 27.iii.1987, Holzenthal, Hamilton & Heyn, 1 male (UMSP); El Salvaje, Río Tabarcia, 8 km (road) E. Palmichal, 9.847° N, 84.164° W, 19–21.i.1992, el. 1650 m, Holzenthal, Kjer & Quesada, 1 male (in alcohol, UMSP).

**Etymology:** This new species is named in honor of Dr. Helio Gallardo Martínez of the Escuela de Filosofía at Universidad de Costa Rica (Costa Rica), in recognition of his outstanding contributions to the development of critical knowledge of the socio-political and ecological reality of Latin America.

**Distribution:** COSTA RICA: Alajuela, Cartago, Guanacaste, Limón, Puntarenas, San José; PANAMA: Chiriquí.

***Wormaldia gonzalezae* Muñoz-Quesada & Holzenthal, new species**

Figures 274–280.

**Diagnosis.** This new species is distinctively characterized from other known members of *Wormaldia* by the shape of tergum VIII. The posteromesal margin of tergum VIII is convexly projected, having 2 small, knob-shaped, mesal processes flanking a slightly spiny section (Fig. 275). The triangular process “b” of tergum X has an unusual position; it arises on the posterior half of the segment (Fig. 275).

**Description.** Adult: Length of male forewing 4.5–5.0 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 279); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 280).

**Male genitalia** (Figs. 274–278): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with posterior margin convexly projected and bearing 2 knob-shaped, small, sublateral processes flanking section with many tiny spines; when viewed laterally, posterodorsal corner showing subovate apex of posteromesal process, slightly directed posteroventrally. Sternum VIII with convex, posteromesal projection, about 0.2 times length of sternum VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly C-shaped in appearance, convexly projected anterad, concave posteriorly; when viewed ventrally, concave anteriorly, sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, conspicuous, nearly lambda-shaped, elongate; process “b” lateral, on upper middle, not very conspicuous, nearly obtusely triangular, slightly elongate, projected laterad; “head” flattened, with anterior apex small and convexly elongate, lateral apices slender, subovally elongate, posterior apex elongate, widely rounded; when viewed laterally, stout, weakly sinuous mid-dorsally, concavely curved preapicodorsally, “head” wide, semicircular, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, narrowly rounded posteriorly; when viewed laterally, strongly elongate subovally, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, widest and convex at midlength, apical segment slender, rectangularly elongate, shorter (about 0.75 times) and narrower than basal segment, rounded and narrowest posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment rectangularly elongate, rounded posteriorly, with subovate, apical patch of short, thin, black, small, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 278).

**Holotype:** Male. **VENEZUELA: Aragua:** 1 km S Rancho Grande, 5.ii.1976, C. M. & O. S. Flint, Jr. (NMNH).

**Paratypes:** **VENEZUELA: Aragua:** Dos Riitos, 6 km N Rancho Grande, [10.352° N, 67.680° W], 4.ii.1976, C. M. & O. S. Flint, Jr., 1 male, 1 female (NMNH); same except, 1 km S Rancho Grande, 5.ii.1976, C. M. & O. S. Flint, Jr., 5 males, 1 female (in UMSP: 2 males, in NMNH: 2 males, in alcohol 1 male, 1 female); Rancho Grande, 22–23.i.1978, J. B. Heppner 1 male (NMNH); same except, 25–26.i.1978, J. B. Heppner, 1 male (NMNH).

**Etymology:** This new species is named in honor of Dr. Ingrid González-Gibson of the Dumbarton Oaks Research Library (Washington D.C.), as a gesture of thanks for her valuable cooperation, encouragement, and friendship to the senior author.

**Distribution:** VENEZUELA: Aragua.

***Wormaldia hedamafera* Muñoz-Quesada & Holzenthal, new species**

Figures 160–166.

**Diagnosis.** The distinctive features of terga VIII and X, and particularly of the inferior appendage, easily separate this new species from the other known species of the genus. In this species, tergum VIII has 2 stout, triangular, posteromesal processes separated by a wide, moderately deep, U-shaped emargination slightly covered basally by a

narrow and weakly convex shelf (Fig. 161). Tergum X lacks process “a”, process “b” is developed into a narrow, elongate band, and the “head” narrowly subtriangular and its anterior apex noticeably narrowly elongate (Fig. 161). Finally, the apical segment of the inferior appendage is very strongly ovally widened posteriorly (Fig. 160).

**Description.** Adult: Length of male forewing 5.0–5.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 165); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 166).

**Male genitalia** (Figs. 160–164): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 conspicuous, stout, triangularly elongate, posteromesal processes separated by broad, moderately deep, U-shaped emargination slightly covered basally by narrow, weakly convex shelf; when viewed laterally, posterior corner with rounded apex of posteromesal process. Sternum VIII straight or very weakly convex posteromesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convex anteriorly, weakly convex posteriorly; when viewed ventrally, weakly concave anteriorly, weakly sinuous posteriorly with very shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” sublateral, conspicuously narrow and elongate band; “head” narrowly subtriangular, anterior apex conspicuous and noticeably narrowly elongate, lateral apices small, convexly projected, posterior apex narrow, rounded; when viewed laterally, dorsally weakly convex at midlength, concavely curved preapicodorsally, “head” wide, subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, rounded apically; when viewed laterally, slender, tubularly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, elongate, shorter (about 0.9 times) than basal segment, rectangular and narrowest at midlength, very strongly subovally widened posteriorly, nearly equal in width to basal segment; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by narrow, deep, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment stout, tubularly elongate, narrowest and subovate posteriorly, with elongate, apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 164).

**Holotype:** Male. **COSTA RICA: Alajuela:** Río Toro, 3 km (road) SW Bajos del Toro, 10.204° N, 84.316° W, el. 1530 m, 3–4.ix.1990, Holzenthal, Blahnik & Huisman (UMSP).

**Paratypes:** **COSTA RICA: Alajuela:** Río Toro, 3 km (road) SW Bajos del Toro, 10.204° N, 84.316° W, el. 1530 m, 3–4.ix.1990, Holzenthal, Blahnik & Huisman, 6 males, 2 females (in INBio: 2 males; in NMNH: 2 males; in UMSP: 2 males, 2 females); same except, 11.ii.1992, Holzenthal, Muñoz & Kjer, 4 males (INBio). **NICARAGUA: Jinotega:** Cerro Kilambé, 13° 34' N, 85° 43' W, el. 1520 m, viii.1997, J. M. Maes & B. Hernández, 3 males (in alcohol, MEL); **Zelaya:** Cerro Saslaya, 13° 44' N, 85° 01' W, el. 700 m, iv.1996, J. M. Maes & J. Hernández, 20 males, 8 females (in INBio: 3 males in alcohol; in MEL: 4 males in alcohol; in UMSP: 3 males in alcohol; in NMNH: 10 males, 8 females in alcohol).

**Additional material examined:** **COSTA RICA: Alajuela:** Volcán Poás, [10° 11' N, 84° 13' W], 28.iv.1984, J. Bueno & E. Barrera, 1 male (IBUNAM); Río La Paz Pequeña, 7.8 km N Vara Blanca, 10.211° N, 84.116° W, el. 1230 m, 13.ii.1986, Holzenthal, Morse, Fasth, 1 male (UMSP); Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 28–30.vii.1990, Holzenthal, Blahnik & Muñoz, 1 male, (in alcohol, UMSP); Quebrada Virgencita, 10.2 km S Bajos del Toro, 10.168° N, 84.326° W, el. 1780 m, 5–6.ix.1990, Holzenthal, Blahnik & Huisman, 4 males, 4 females (UMSP); Quebrada Latas, 8.9 km NE Bajos del Toro, 10.269° N, 84.260° W, el. 1030 m, 6.ix.1990, Holzenthal, Blahnik & Huisman, 1 male, 3 females (UMSP), [Ciudad Quesada] Río Peje and falls, carretera 1 km SE San Vicente, 10.277° N, 84.388° W, el. 1450 m, 14–15.ii.1992, Holzenthal, Muñoz & Kjer, 2 males (1 male in alcohol, INBio); **Cartago:** Reserva Tapanti, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 9–10.v.1990, Holzenthal & Blahnik, 21 males, 4 females (8 males, 1 female in alcohol, UMSP); same except, 10–13.ix.1991, Fdo. Muñoz-Q. & F. A. Quesada, 1 male (INBio); 10.ii.1994, Fdo. J. Muñoz-Q., 5 males (in alcohol, INBio); same except, Quebrada Palmitos and



falls, 9.72° N, 83.78° W, el. 1400 m, 23.viii.1990, Holzenthal & Huisman, 1 male (INBio); **Guanacaste:** Área de Conservación Guanacaste (ACG), Estación Maritza, 10.958° N, 85.497° W, el. 550 m, ii.1994, Fdo. Muñoz-Q., 1 male (in alcohol, INBio); **Heredia:** Quebrada Amistad, 1.8 km (road) NW Porosatí, 10.097° N, 84.119° W, el. 1920 m, 8.ii.1992, Holzenthal, Muñoz, Kjer, 1 male (INBio); **Puntarenas:** Río Cotón in Las Alturas, 8.938° N, 82.826° W, el. 1360 m, 16.ii.1986, Holzenthal, Morse & Fasth, 1 male (in alcohol, UMSP); Río Bellavista, 1.5 km NW Las Alturas, 8.951° N, 82.846° W, el. 1400 m, 10–11.viii.1990, Holzenthal, Blahnik & Muñoz, 1 male, 2 females (UMSP); same except, 16–17.viii.1991, Holzenthal, Muñoz & Huisman, 1 male (in alcohol, UMSP); Reserva Bosque Nuboso Monteverde, Quebrada Cuecha, 10.31° N, 84.79° W, el. 1550 m, 28.ii.1986, Holzenthal & Fasth, 3 males (UMSP); **San José:** Parque Nacional Braulio Carrillo, Río Zurquí, 10.059° N, 84.019° W, el. 1650 m, 5.ii.1986, Morse & Fasth, 1 male, 3 females (UMSP); same except, 12.vi.1988, C. M. & O. S. Flint, Jr., 10 males (NMNH); 6.2 km NE administrative building, 10.09° N, 83.97° W, el. 1100 m, 6.ii.1986, Holzenthal & Morse, 1 male (UMSP); 1.4 km NE administrative building, 10.067° N, 84.009° W, el. 1510 m, 6.ii.1986, Holzenthal & Morse, 5 males, 1 female (in alcohol, UMSP); Quebrada Caraigres, 2.5 km (road) SW La Legua, 9.734° N, 84.120° W, el. 1470 m, 22.i.1992, Holzenthal, Kjer & Quesada, 1 male (INBio); same except, Trib. to Quebrada Caraigres, 3.6 km (road) SW La Legua, 9.728° N, 84.125° W, el. 1650 m, 23.i.1992, Holzenthal, Kjer & Quesada, 2 males (INBio). **NICARAGUA: Esteli:** Área Protegida Mirafior, Quebrada Grande, río arriba, 13° 13.327' N, 86° 15.557' W, el. 1200 m, 19.vii.2000, Chamorro & Lacayo, 1 male (in alcohol, MEL); **Jinotega:** Cerro Kilambé, detrás del Campamento, 13° 35.216' N, 85° 42.722' W, 30.vii.2001, Chamorro, 1 male (in alcohol, MEL); Peñas Blancas, 13° 17' N, 85° 33' W, el. 1300 m, 25.vii.1997, J. M. Maes & B. Hernández, 3 males (in alcohol, MEL); Área Protegida Datanli-El Diablo, La Quebradona, 1 km NE de Santa Maura, 13° 10.389' N, 85° 51.404' W, el. 1050 m, 29.vii.2000, Chamorro, Lacayo & Christensen, 4 males (in alcohol, MEL).

**Etymology:** This new species is named in honor of **Henry David**, **María Fernanda**, and **Raquel Rodríguez Muñoz**, as a gesture of gratitude and recognition for their appreciable and kind family spirit, cooperation, and encouragement to the senior author.

**Distribution:** COSTA RICA: Alajuela, Cartago, Guanacaste, Heredia, Puntarenas, San José; NICARAGUA: Esteli, Jinotega, Zelaya.

### ***Wormaldia imberti* Muñoz-Quesada & Holzenthal, new species**

Figures 126–130.

**Diagnosis.** This new species, *W. contrerasi*, *W. francovilla*, and *W. machadorum*, new species, are easily distinguished from the other known species in the genus by a combination of distinctive features of segments IX and X. The anterior margin of segment IX is strongly acutely projected (best seen laterally, Figs. 121, 126, 131, 136). Tergum X is slender, tubular, and prominently elongate (at least 1.5 times the length of the superior appendage, Figs. 121, 122, 126, 127, 131, 132, 136, 137). This new species can be distinguished from those 3 species by shapes of terga VIII and X, and the shape of the inferior appendage.

In *W. imberti*, the posterior margin of tergum VIII has a deep, U-shaped, mesal emargination, that is slightly covered basally by a concave shelf (Fig. 127). Tergum X has process “a” prominent and lambda-shaped (Fig. 127). The inferior appendage has a slender, nearly thumb-shaped apical segment, which is slightly upcurved at midlength and approximately equal in length to the basal segment (Fig. 126). Finally, the diagnostic characteristics of the other species are specified in their respective diagnoses.

**Description.** Adult: Length of male forewing 4.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps light brown, with brown setae. Labial palps light brown, with brown setae. Dorsum of thorax light brown. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 141); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 142).

**Male genitalia** (Figs. 126–130): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly convexly projected posterad, having deep, U-shaped, spiny, posteromesal emargination apicolaterally, slightly covered basally by deeply concave shelf; when viewed laterally, posterior margin weakly concave and dorsally produced posteriorly. Sternum VIII with convex, posteromesal projection, about 0.1 times length of



sternum VIII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, triangular in appearance, anterior margin with conspicuous, triangular projection very strongly acutely elongate, posterior margin slightly sinuous posteriorly; when viewed ventrally, widely concave anteriorly, weakly sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, strongly subtriangularly elongate, with process “a” anteromesal, conspicuous, lambda-shaped, elongate, reaching lower middle of tergum; process “b” lateral on lower middle, obtusely triangular, elongate, projected laterad; “head” slender, rounded; when viewed laterally, expanded convexly anterodorsally, slender and tubular at midlength, dorsally finely sinuous, “head” rounded. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded apically; when viewed laterally, slightly tubularly elongate, reaching middle of segment X, rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal segment thick, subrectangular, elongate, broadest at midlength, convex dorsally, straight ventrally, apical segment stout, nearly thumb-shaped elongate, relatively equal in length, but narrower than basal segment, slightly upcurved and narrowest at midlength; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by moderately deep, wide, V-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment rectangular at midlength and triangular posteriorly, with inner margin nearly straight, bearing short, black, small, peg-shaped setae scattered on mesal surface. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal, spine-shaped sclerite (Fig. 130).

**Holotype:** Male. **COSTA RICA: Puntarenas:** Península de Osa, Corcovado, Estación Sirena, [8° 29' N, 83° 35' W], 13.v.1993, Fdo. Muñoz-Q. (NMNH).

**Paratype:** **COSTA RICA: Puntarenas:** Península de Osa, Corcovado, Estación Sirena, [8° 29' N, 83° 35' W], 13.v.1993, Fdo. Muñoz-Q., 1 male (in alcohol, UMSP).

**Etymology:** This new species is named in honor of Dr. Juan Bosco Imbert Rodríguez of the Universidad de Navarra (Navarra, Spain), as a gesture of thanks for his cooperation, encouragement, and friendship.

**Distribution:** COSTA RICA: Puntarenas.

### ***Wormaldia inca* Muñoz-Quesada & Holzenthal, new species**

Figures 85–89.

**Diagnosis.** This new species, *Wormaldia aymara*, *W. dachiardiorum*, and *W. insignis*, are easily distinguished by the conspicuously elongate and distinctive posterodorsal projection of segment IX (best seen laterally, Figs. 75, 80, 85, 90), which is not present in other known species of this genus. *Wormaldia inca* differs from these 3 species in the shapes of terga VIII and X, segment IX, and the inferior appendage. In *W. inca*, tergum VIII has a conspicuously rectangular posteromesal process (Fig. 86). The posterodorsal projection of segment IX is slender, strongly elongate, and weakly downcurved (Fig. 85). Process “a” of tergum X is absent (Fig. 85). The apical segment of the inferior appendage is rectangular and truncate posteriorly (Fig. 85).

**Description.** Adult: Length of male forewing 4 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 95); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 96).

**Male genitalia** (Figs. 85–89): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII produced posterolaterally into 2 slight, convex projections flanking slightly elongate, conspicuously wide, rectangular process; when viewed laterally, posterodorsal corner with apices of posterolateral projection and posteromesal process. Sternum VIII with convex, posteromesal projection, about 0.2 times length of segment VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly quadrate in appearance, convex anteriorly, posterior margin concave, and possessing slender, tubular, strongly elongate, dorsal projection, weakly downcurved; when viewed ventrally, weakly concave anteriorly, straight posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” lateral on lower middle, conspicuous, semioval, elongate; “head” small, subtriangular, with anterior

apex widened, semicircular, lateral apices tiny, convexly projected, posterior apex small, rounded; when viewed laterally, slender, “head” semiovalate, with anterior apex acutely projected dorsad. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout at midlength, rounded apically; when viewed laterally, elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, rectangular, strongly elongate, broadest and convex at midlength, apical segment stout, rectangularly elongate, noticeably shorter (about 0.6 times) and narrower than apical segment, weakly concave at midlength, slightly widened and truncated posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by wide, moderately deep, U-shaped emargination posteromesally, each basal segment stout, slightly widened at midlength, with outer margin convexly curved, apical segment stout, subrectangularly elongate, weakly incurved at midlength, widened, truncate posteriorly, with apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with several visible, internal sclerites (Fig. 89).

Holotype: Male. PERU: Huánuco: Tingo María, [9° 18' S, 75° 59' W], el. 672 m, 1–6.ii.1980, J. B. Heppner (in alcohol, NMNH).

Paratype: PERU: Huánuco: Tingo María, [9° 18' S, 75° 59' W], el. 672 m, 1–6.ii.1980, J. B. Heppner 1 female (in alcohol, NMNH).

Etymology: This new species is named in honor of the descendants of the Incas, who inhabit in the Andean region of South America, especially in Peru.

Distribution: PERU: Huánuco.

### ***Wormaldia insignis* (Martynov 1912)**

Figures 90–96.

*Dolophilus insignis* Martynov 1912, 29, 30, 40, figs. 45–47, male, Peru: Callanga (Coll. Zool. Mus. Imperial Acad. St. Petersburg).

*Wormaldia insignis* (Martynov); Ross 1949, 155, 156; 1956, 62, 64. *Wormaldia ostina* Ross 1956, 40, 61, 64, figs. 73 A–B, 125, 126, male, Peru: Cusco (INHS); Flint 1975, 568 (synonym of *W. insignis*).

Diagnosis. Ross placed *W. insignis* and *W. ostina* in the *W. arizonensis* Group (Ross 1949, 1956). This species is closely related to *W. aymara*, *W. dachiardiorum*, and *W. inca*. Segment IX in these 4 species has a conspicuously elongate projection posterodorsally, which is not present in the other known species of *Wormaldia* (best seen laterally, Figs. 75, 80, 85, 90). However, *W. insignis* is easily separated from those 3 species by the shapes of terga VIII and X. In this new species, tergum VIII has a stout, elongate, digitate process posteromesally (Fig. 91). Tergum X has process “a” divided into 2 separate and anterolateral processes, and each process is slender and subovally elongate (Fig. 91).

Description. Adult: Length of male forewing 3.5–4.0 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, lighter setae. Maxillary palps yellowish, with lighter setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 95); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 96).

Male genitalia (Figs. 90–94): Sternum VII with broad, convex, posteromesal projection, less than 0.2 times length of sternum VIII. Tergum VIII slightly projected posterolaterad, having narrow, conspicuously elongate, digitate process posteromesally, surpassing bases of tergum X and superior appendages; when viewed laterally, posterodorsal corner with slender apex of posterior process. Sternum VIII with conspicuous, broad, convex, posteromesal projection, about 0.3 times length of sternum VIII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly subquadrate in appearance, convexly projected anterad, posterior margin concave, having conspicuous, triangularly projected, dorsal projection; when viewed ventrally, slightly concave anteriorly, straight posteriorly, with slight, shallow concavity mesally. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” divided into 2 separated anterolateral processes, each small, narrow, subovally elongate; process “b” sublateral, conspicuous, semiovalate, elongate, projected laterad; “head” subtriangular, with anterior apex inconspicuous, lateral apices convexly projected, posterior apex small, convex;

when viewed laterally, slender, weakly sinuous dorsally, “head” slightly bulged ovals. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded apically; when viewed laterally, tubularly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, tubularly elongate, shorter (about 0.8 times) and narrower than apical segment, weakly concave on ventral edge, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/5ths, separated posteromesally by narrow, deep, V-shaped emargination, each basal segment stout, widest at midlength, with outer margin slightly convexly curved, apical segment tubularly elongate, rounded posteriorly, with apicolateral patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 94).

**Material examined:** PERU: Cuzco: Santa Isabel, Valley of Cosnipata, 9.i.1952, F. Woytkowsky, 1 male (INHS-Trichoptera 22269); Madre de Dios: Manú, Biosphere Reserve Pakitza, 11° 56' S, 71° 18' W, el. 350 m, 30.ix.1987, M.G. Pogue, 1 male (NMNH).

Distribution: PERU: Cuzco, Madre de Dios (**new record**).

### ***Wormaldia isela* Muñoz-Quesada & Holzenthal, new species**

Figures 7–10.

**Diagnosis.** This new species, together with *W. dorsata*, *W. fredycarol*, *W. luma*, *W. maesi*, new species, and *W. palma*, are easily distinguished from the other species of *Wormaldia* by sharing several distinctive features of segments IX and X. In these species, segment IX has a hook-shaped projection anterodorsally (best seen laterally, Figs. 7, 11, 18, 23, 28, 33). Tergum X is stout, triangular, without process “a”, the “head” wide, rounded posteriorly, and without lateral apices (Figs. 8, 12, 19, 24, 29, 34). However, *W. isela* can be distinguished from those 5 species by the combination of several distinctive features. In this new species, tergum VIII has a wide, moderately deep, posteromesal concavity with a conspicuous, semioval, and subdorsal pouch (Fig. 8). Tergum X is triangularly elongate, with process “b” developed into a slight and subtriangular projection, the “head” is conspicuous and widely rounded; when viewed laterally, the “head” is tubularly rounded (Figs. 7–8). The apical segment of the inferior appendage is noticeably broad at midlength and somewhat narrower than the basal segment (Fig. 7).

**Description.** Adult: Length of male forewing 7–8 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 16); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 17).

**Male genitalia** (Figs. 7–10): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII possessing wide, moderately deep, posteromesal concavity, with conspicuous, semioval pouch subdorsally; when viewed laterally, posterodorsal corner widely rounded. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, anterior margin deeply concave, with wide, oval enlargement mesally; when viewed laterally, broad, nearly triangular in appearance, with slender, hook-shaped projection anterodorsally, with broad, convex, strongly elongate projection anteriorly, sinuous posteriorly; when viewed ventrally, strongly concave anteriorly, sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, strongly elongate triangularly, with process “a” absent; process “b” sublateral, developed into slight, triangular projection directed anterolaterad; “head” conspicuous, widely rounded; when viewed laterally, “head” tubularly rounded. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, subovate; when viewed laterally, strongly tubularly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment thick, subrectangularly elongate, broadest and convex at midlength, apical segment broad, subrectangularly elongate, slightly widened at midlength, nearly equal in length, slightly narrower than basal segment, widely rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by

moderately deep, narrow, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment subrectangularly elongate, with inner margin convex and bearing thin, black, spine-shaped setae scattered on mesal surface and in elongate, apicolateral patch. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with highly convoluted membranous section making difficult to distinguish internal sclerites.

**Holotype:** Male. **MEXICO: Nuevo León:** Santiago, Potrero Redondo, 10.v.1985, A. Contreas-R. (in alcohol, IBUNAM).

**Paratypes:** **MEXICO: Nuevo León:** Santiago, Potrero Redondo, 10.v.1985, A. Contreas-R., 3 males, 2 females (in NMNH: 1 male in alcohol; in UMSP: 1 male in alcohol; in IBUNAM: 1 male, 2 females in alcohol); **Oaxaca:** Pluma Hidalgo, Ruta 175, Oaxaca-Puerto Ángel, [16° 06' N, 96° 28' W], 27.xi.1985, H. Velasco, 1 male (in alcohol, IBUNAM); **San Luis Potosí:** 4 mi S of Tamazunchale, 27.vi.1965, O.S. Flint, 2 males, 1 female (NMNH).

**Etymology:** This new species is named in honor of Lic. Claudia Isela Torres Navarro (Aguascalientes, México), as a gesture of thanks by the senior author for her cooperation, friendship, and encouragement.

**Distribution:** MEXICO: Nuevo León, Oaxaca, San Luis Potosí.

### ***Wormaldia juarox* Muñoz-Quesada & Holzenthal, new species**

Figures 199–205.

**Diagnosis.** This new species is easily distinguished from all other known species of *Wormaldia* by the complex shape of tergum VIII posteriorly. The posterior margin of tergum VIII has a wide, deep, U-shaped, mesal emargination flanked by 2 conspicuous, subglobose, subdorsal processes, which all are covered basomedially by a shelf with a digitate mesal process (Fig. 199).

**Description.** Adult: Length of male forewing 4–5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 204); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 205).

**Male genitalia** (Figs. 199–203): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with wide, deep, concave, posteromesal emargination flanked by 2 conspicuous, wide, subglobose, subdorsal processes, which all are covered basomedially by shelf with digitate, mesal process; when viewed laterally, posterodorsal corner with acute apex of posterosubdorsal process. Sternum VIII very slightly convex posteromesally, about 0.1 times length of sternum VIII. Segment IX, when viewed dorsally, slightly concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, slightly convex anteriorly, slightly concave posteriorly; when viewed ventrally, slightly concave anteriorly, very weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, conspicuous, triangular, elongate, nearly reaching lower middle of tergum; process “b” lateral on lower middle, obtusely triangular, elongate, projected laterad; “head” subtriangular, with anterior apex conspicuous, wide, knob-shaped, lateral apices subtriangularly projected, posterior apex small, widely rounded; when viewed laterally, extended at midlength, concavely curved preapicodorsally, “head” wide, subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, subtriangularly elongate; when viewed laterally, subovally elongate at midlength, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment slender, rectangular, tubularly elongate, shorter (about 0.9 times) and narrower than basal segment, widely rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by narrow, moderately deep, V-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment stout, tubularly elongate, subovally widened posteriorly, with elongate, apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 203).



**Holotype:** Male. **COSTA RICA: Cartago:** Reserva Tapanti, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 10–13.ix.1991, Fdo. Muñoz & F. A. Quesada (NMNH).

**Paratypes:** **COSTA RICA: Cartago:** Reserva Tapanti, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 10–13.ix.1991, Fdo. Muñoz & F. A. Quesada, 1 male (UMSP); Ríos Tuas & Pejibaye, 9° 49' N, 83° 42' W, el. 750 m, 15.ix.1991, Fdo. Muñoz & F. A. Quesada, 1 male (NMNH); **Guanacaste:** Zona Protectora Tenorio, tribs. to Río San Lorenzo, 6 km NW Tierras Morenas, 10.61° N, 84.96° W, el. 900 m, 17–19.ii.1992, Holzenthal, Muñoz & Kjer, 2 males (UMSP); **Heredia:** Puerto Viejo, Río Chilamate, 10° 28' N, 84° 1' W, el. 75 m, vi.1990, Fdo. Muñoz, 1 male (in alcohol, INBio).

**Etymology:** This new species is named in honor of Lics. **Juan** and **Roxana** Quirós Vargas (San José, Costa Rica), as a gesture of gratitude for their cooperation and friendship.

**Distribution:** COSTA RICA: Cartago, Guanacaste, Heredia.

### *Wormaldia lauglo* Muñoz-Quesada & Holzenthal, new species

Figures 187–191.

**Diagnosis.** Among known species of *Wormaldia*, this new species is easily recognized by its characteristic shapes of terga VIII and X, as well as by the shape of inferior appendages. In *W. lauglo*, tergum VIII has a posteromesal shelf that is conspicuously serrated or spiny (Fig. 188). Process “b” of tergum X is prominent and triangular (Fig. 188). Finally, the apical segment of the inferior appendage is stout and clearly thumb-shaped (Fig. 187).

**Description.** Adult: Length of male forewing 4 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 197); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 198).

**Male genitalia** (Figs. 187–191): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 conspicuous, stout, elongate, knob-shaped, posteromesal processes separated by wide, deep, U-shaped emargination covered basomedially by shelf strongly serrated or spiny; when viewed laterally, posterodorsal corner with acute apex of posterior process. Sternum VIII with slight, convex projection posteromesally, less than 0.2 times length of sternum VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subtriangular in appearance, with broad, slightly elongate, convex projection anteriorly, slightly sinuous posteriorly; when viewed ventrally, concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, lambda-shaped, strongly elongate, reaching middle of tergum; process “b” sublateral, prominent, subtriangular, elongate, projected laterad; “head” subtriangular, wide, with anterior apex narrowly elongate, lateral apices conspicuous, triangularly projected, posterior apex wide, rounded; when viewed laterally, strongly enlarged convexly mid-dorsally, narrowly concavely curved preapicodorsally, “head” wide, subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate at midlength; when viewed laterally, elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, thumb-shaped, elongate, slightly longer (about 1.1 times) and narrower than basal segment, slightly downcurved at midlength, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by broad, deep, V-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment stout, thumb-shaped, with elongate, apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal, hook-shaped sclerite (Fig. 191).

**Holotype:** Male. **PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 8.iii.–16.v.1978, H. Wolda (in alcohol, NMNH).

**Paratype: PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 14–27.iii.1979, H. Wolda, 1 male (in alcohol, NMNH).

**Etymology:** This new species is named in honor of **Laura L. Ospina Santacruz** and **Gloria S. Santacruz Muñoz**, as a gesture of gratitude for their appreciable and kind friendship, encouragement, and cooperation during the senior author's student days in Minnesota.

**Distribution:** PANAMA: Chiriqui.

### ***Wormaldia luma* Bueno-Soria & Holzenthal 1986**

Figures 23–27.

*Wormaldia luma* Bueno-Soria & Holzenthal 1986, 140, figs. 7–9, male, México: Oaxaca (IBUNAM).

**Diagnosis.** Bueno-Soria & Holzenthal (1986) placed this species in the *W. arizonensis* Group of Ross (1949, 1956). *Wormaldia luma*, *W. dorsata*, *W. fredycarol*, *W. isela*, *W. maesi*, new species, and *W. palma*, are closely related. They are distinguished from the other known species of *Wormaldia* by sharing distinctive features of segments IX and X. In these 6 species, segment IX has a nearly hook-shaped projection anterodorsally (best seen laterally, Figs. 7, 11, 18, 23, 28, 33). Segment X, which is stout, nearly triangularly elongate, without process “a”, and with the “head” rounded posteriorly and without lateral apices (Figs. 8, 12, 19, 24, 29, 34), also has a similar appearance dorsally. *Wormaldia luma* differs from the other 5 species by the shapes of terga VIII and X. In *W. luma*, tergum VIII has a wide, posteromesal concavity, and a narrow, subdorsomesal pouch parallel to the posteromesal concavity (Fig. 24). Tergum X has process “a” absent, process “b” narrow, and the “head” wide, with the anterior apex tiny, semicircular, and with the posterior apex narrowly rounded; when viewed laterally, the “head” is wide and nearly subtriangular.

**Description.** Adult: Length of male forewing 5.5 mm. Head brown, with light brown setae. Antenna long, slender, brown, with small, dark brown setae. Maxillary palps light brown, with brown setae. Labial palps light brown, with brown setae. Dorsum of thorax light brown. Legs brown, with small, dark brown setae. Forewing yellowish, covered with fine, small, dark brown setae, with apical forks I, II, III, IV, and V present; hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present.

**Male genitalia** (Figs. 23–27): Sternum VII with posterior margin straight or very weakly convex mesally. Tergum VIII with conspicuous, wide, posteromesal concavity, and very narrow and subdorsal pouch parallel to posteromesal concavity; when viewed laterally, margins straight. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, anterior margin concave bearing small, ovate, mesal enlargement; when viewed laterally, broad, nearly subquadrate in appearance, with slender, hook-shaped projection anterodorsally, with broad, slightly elongate, convex projection anteriorly, weakly sinuous posteriorly; when viewed ventrally, concave anteriorly, sinuously concave posteriorly. Segment X, when viewed dorsally, noticeably triangularly elongate, with process “a” absent; process “b” sublateral, elongate, narrow; “head” wide, with anterior apex tiny, semicircular, lateral apices absent, posterior apex narrowly rounded; when viewed laterally, slender, concavely curved preapicodorsally, “head” wide, nearly subtriangular. Superior appendage digitate; when viewed dorsally, parallel with segment X, bulged at midlength, widely rounded apically; when viewed laterally, slender, tubularly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment slender, nearly rectangular, tubularly elongate, slightly shorter and narrower than basal segment, convexly rounded and narrowest posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, broad, V-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment slender, subtriangular elongate, weakly incurved at midlength, narrowest posteriorly, with short, black, spine-shaped and peg-shaped setae covering mesal surface. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with various visible, internal sclerites (Fig. 27).

**Material examined: MEXICO: Oaxaca:** Ruta 175, La Esperanza, cerca Valle Nacional, 18.iv.1983, M. García & A. Ibarra, 1 male (Holotype) (IBUNAM).

**Distribution:** MEXICO: Oaxaca.

***Wormaldia machadorum* Muñoz-Quesada & Holzenthal, new species**

Figures 136–142.

**Diagnosis.** This new species shares the following characters with *W. contrerasi*, *W. francovilla*, and *W. imberti*: 1) the anterior margin of segment IX has a conspicuous, wide, and acutely elongate projection (best seen laterally, Figs. 121, 126, 131, 136); and 2) tergum X is slender, tubular, and prominently elongate (at least 1.5 times the length of the superior appendage, Figs. 121, 122, 126, 127, 131, 132, 136, 137). This combination of diagnostic characteristics can be used to separate these 4 species from the other known species of *Wormaldia*. *Wormaldia machadorum* can be distinguished from the other 3 species by the distinctive shapes of terga VIII and X, as well as the inferior appendages. In this new species, the posterior margin of tergum VIII is sinuously projected posterad with, 2 conspicuous, slender, sublateral processes (Fig. 137). Tergum X has process “a” light, wide, nearly rectangular (Fig. 137). The apical segment of the inferior appendage is nearly subtriangularly elongate and shorter than the basal segment (Fig. 136).

**Description.** Adult: Length of male forewing 5–6 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 141); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 142).

**Male genitalia** (Figs. 136–140): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly sinuously projected posteromesad, having very shallow, mesal concavity flanked by 2 elongate, slender processes; when viewed laterally, posterodorsal corner with subovate apex of posterior process. Sternum VIII with weak, wide, convex projection posteromesally, about 0.1 times length of sternum VIII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, triangular in appearance, anterior margin with broad, strongly elongate, convex projection, posterior margin concave; when viewed ventrally, widely concave anteriorly, slightly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, strongly subtriangularly elongate, with process “a” weakly developed, subrectangular at midlength; process “b” lateral on lower middle, conspicuous, subovate, elongate, convexly projected laterad; “head” slender, rounded, with anterior apex tiny, weakly semioval; when viewed laterally, clearly slender, tubular, concavely curved preapicodorsally, “head” subovally elongate, hook-shaped. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, bulged at midlength, rounded apically; when viewed laterally, slightly tubularly elongate, reaching middle of segment X, rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, triangularly elongate, shorter (about 0.8 times) and narrower than basal segment, rounded and narrowest posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, wide, V-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment slender, subtriangularly elongate, narrowest posteriorly, with inner margin slightly concave and bearing short, black, small, peg-shaped setae scattered on mesal surface. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 140).

**Holotype:** Male. **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 1–4.v.1990, Holzenthal & Blahnik, male (UMSP).

**Paratypes:** **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 2–4.vii.1986, Holzenthal, Heyn & Armitage, 1 male (UMSP); same except, 1–4.v.1990, Holzenthal & Blahnik, 1 male (NMNH); **Puntarenas:** Reserva Bosque Nuboso Monteverde, Quebrada Cuecha, 10.31° N, 84.79° W, el. 1550 m, 28.ii.1986, Holzenthal & Fasth, 1 male (INBio); **San José:** Parque Nacional Braulio Carrillo, Río Zurquí, 10.059° N, 84.019° W, el. 1650 m, 12.vi.1988, C. M. & O. S. Flint, Jr. & Holzenthal, 1 male (NMNH). **PANAMA: Chiriquí:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 8.iii.–16.v.1978, H. Wolda, 2 males (in alcohol, UMSP); same except, 31.v.–25.vii.1978, H. Wolda, 1 male (in alcohol, NMNH); 20.ix.–12.xii.1978, H. Wolda, 7 males (in alcohol, NMNH).

**Etymology:** This new species is named in honor of Drs. José Luis, Beth Machado, and their children (Swarthmore College, Pennsylvania), as a gesture of thanks for their cooperation, encouragement, and friendship.

**Distribution:** **COSTA RICA:** Alajuela, Puntarenas, San José; **PANAMA:** Chiriquí.

### ***Wormaldia maesi* Muñoz-Quesada & Holzenthal, new species**

Figures 28–32.

**Diagnosis.** This new species, *W. dorsata*, *W. fredycarol*, *W. isela*, *W. luma*, and *W. palma*, are distinctly different from the other known species of *Wormaldia* and share the following characters in combination: 1) segment IX has a nearly hook-shaped projection anterodorsally (best seen laterally, Figs. 7, 11, 18, 23, 28, 33); and 2) tergum X is stout and nearly triangular, without process “a”, and with the “head” wide, rounded posteriorly, and without lateral apices (Figs. 8, 12, 19, 24, 29, 34). However, *W. maesi* can be readily distinguished from the other 5 species by the following characters in combination: 1) tergum VIII has the posterior margin sinuously projected posterad, with a conspicuous, semioval, and subdorsal pouch mesally (Fig. 29); and 2) tergum X is triangularly elongate, without processes, and with the “head” narrowed and rounded; when viewed laterally, the “head” is tubularly narrow and rounded (Figs. 28–29).

**Description.** Adult: Length of male forewing 5.0–5.5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 16); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 17).

**Male genitalia** (Figs. 28–32): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII conspicuously sinuously projected posterad with conspicuous, semioval, subdorsal pouch projected anterad; when viewed laterally, posterodorsal corner produced posteriorly. Sternum VIII with posterior margin slightly convexly projected. Segment IX, when viewed dorsally, anterior margin concave bearing ovate, mesal enlargement; when viewed laterally, broad, nearly triangular in appearance, with slender, hook-shaped projection anterodorsally, with broad, strongly elongate, convex projection anteriorly, sinuous posteriorly; when viewed ventrally, deeply concave anteriorly, sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, strongly triangularly elongate, slightly bulged at midlength, narrowed and rounded posteriorly; processes “a” and “b” absent; when viewed laterally, “head” tubularly narrow, rounded. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, narrowly rounded apically; when viewed laterally, stout, strongly elongate subovally, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment slender, rectangular, tubularly elongate, nearly equal in length and strongly narrower than basal segment, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, narrow, U-shaped emargination, each basal segment stout, slightly widest at midlength, with outer margin convexly curved, apical segment nearly tubularly elongate, rounded posteriorly, with thin, black, spine-shaped setae scattered on mesal surface and in elongate, apicolateral patch on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with many visible, internal sclerites (Fig. 32).

**Holotype:** Male. **NICARAGUA: Zelaya:** Cerro Saslaya, 13° 44' N, 85° 01' W, el. 700 m, iv.1996, J. M. Maes & J. Hernández (NMNH).

**Paratypes:** **NICARAGUA: Jinotega:** Cerro Kilambé, 13° 34' N, 85° 43' W, el. 1520 m, viii.1997, J. M. Maes & B. Hernández, 1 male (in alcohol, MEL); **Zelaya:** Cerro Saslaya, 13° 44' N, 85° 01' W, el. 700 m, iv.1996, J. M. Maes & J. Hernández, 2 males (in NMNH: 1 male in alcohol; in UMSP: 1 male in alcohol).

**Etymology:** This new species is named in honor of Dr. Jean Mitchel Maes of the Museo Entomológico de León (Nicaragua), as a gesture of thanks for his valuable cooperation and friendship, and in recognition of his outstanding contribution to the study and conservation of the Nicaraguan biodiversity.

**Distribution:** NICARAGUA: Jinotega, Zelaya.

### ***Wormaldia matagalpa* Flint 1995**

Figures 281–287.

*Wormaldia matagalpa* Flint 1995, 8, 9, figs. 1–3, male, Nicaragua: Matagalpa (NMNH).



Diagnosis. Flint (1995) placed this species in the *W. arizonensis* Group of Ross (1949, 1956). In *W. matagalpa*, tergum VIII has 2 slender, knob-shaped posteromesal processes flanking a conspicuous, subrectangularly elongate process. This distinctive shape of the posterior margin of tergum VIII is a diagnostic feature for identifying this species from the other known species of *Wormaldia* (Fig. 282).

Description. Adult: Length of male forewing 4–5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 286); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 287).

Male genitalia (Figs. 281–285): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with 2 conspicuous, slender, elongate, posteromesal processes separated by conspicuous, subrectangular process; when viewed laterally, posterior margin dorsally with apices of posterior processes. Sternum VIII straight or very slightly convex posteromesally. Segment IX, when viewed dorsally, slightly concave anteriorly; when viewed laterally, broad, rectangular in appearance, convex anteriorly, relatively straight posteriorly; when viewed ventrally, slightly concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, conspicuous, Y-shaped, with slight and wide bifurcation; process “b” sublateral, obtusely triangular, strongly elongate, projected laterad; “head” subtriangularly elongate, with anterior apex slender, conspicuously elongate, lateral apices subtriangular, convexly projected, posterior apex convexly elongate; when viewed laterally, sinuously extended mid-dorsally, concavely curved preapicodorsally, “head” wide, subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, narrowly rounded posteriorly; when viewed laterally, slightly elongate, shorter than segment X, wide, subovally elongate at midlength. Inferior appendage 2-segmented; when viewed laterally, basal segment broad, subrectangular, elongate, widest and convex at midlength, apical segment slender, subrectangularly elongate, shorter (about 0.7 times) and narrower than basal segment, narrowest and rounded posteriorly; when viewed dorsally, apical segment stout, widely rounded posteriorly, with ovate, apical patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by deep and V-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 285).

**Material examined:** **COSTA RICA:** **Guanacaste:** Zona Protectora Tenorio, tribs to Río San Lorenzo, 6 km NW Tierras Morenas, 10.61° N, 84.98° W, 17–19.ii.1992, el. 990 m, Hozenthal, Muñoz & Kjer, 1 male (INBio). **GUATEMALA:** **Izabal:** Matías Gálvez, 14–16.viii.1965, Flint & Ortiz, 2 males, 1 female (in IBUNAM: 1 male in alcohol; in NMNH: 1 male, 1 female in alcohol). **NICARAGUA:** **Jinotega:** Peñas Blancas, 13° 17' N, 85° 33' W, el. 1300 m, 25.vii.1997, J. M. Maes & J. Hernández, 2 males (in alcohol, MEL); same except, Cerro Kilambé, 13° 34' N, 85° 43' W, el. 1520 m, viii.1997, J. M. Maes & J. Hernández, 1 male (in alcohol, MEL); Cerro Mazú, 14° 33' N, 85° 07' W, el. 1300 m, 7–10.ix.1997, J. M. Maes & J. Hernández, 5 males (in MEL: 2 males in alcohol; UMSP: 3 males in alcohol); Área Protegida Datanli-El Diablo, La Quebradona, 1 km NE de Santa Maura, 13° 10.389' N, 85° 51.404' W, el. 1050 m, 29.vii.2000, Chamorro, Lacayo & Christensen, 1 male (in alcohol, MEL); Cerro Kilambé, detrás del Campamento 13° 35.216' N, 85° 42.722' W, el. 1200 m, 30.vii.2001, Chamorro, 1 male, 2 females (in alcohol, MEL); **Matagalpa:** on the road Matagalpa-Jinotega, Fuente Pura, 13° 01' N, 85° 44' W, el. 1300 m, 22.i.1994, J. M. Maes, J. Téllez & E. Van Den Berghe, 1 male (Holotype, NMNH); **Zelaya:** Cerro Saslaya, 13° 44' N, 85° 01' W, el. 700 m, iv.1996, J. M. Maes & J. Hernández, 5 males (in alcohol, NMNH).

Distribution: **COSTA RICA (new record):** Guanacaste; **GUATEMALA (new record):** Izabal; **NICARAGUA:** Jinotega (**new record**), Matagalpa, Zelaya (**new record**).

### *Wormaldia menchuae* Muñoz-Quesada & Holzenthal, new species

Figures 192–198.

Diagnosis. Among known species of *Wormaldia*, this new species, *W. calderonae*, and *W. trondi*, new species, can

be distinguished by their similarly developed tergum VIII. Tergum VIII in these species has a posteromesal shelf with its margin concavely developed, or with 2 conspicuous, elongate, horn-like or digitate processes (Figs. 193, 207, 212). *Wormaldia menchuae* is distinguished from the other 2 species by the shapes of terga VIII and X. In this species, tergum VIII has 2 stout, triangular, posteromesal projections followed by a shelf with its posterior margin concavely produced (Fig. 193). Tergum X has process “a” conspicuous and lambda-shaped, and the “head” widely subovate, with the anterior apex stout and conspicuously elongate (Fig. 193).

**Description.** Adult: Length of male forewing 4.5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 197); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 198).

**Male genitalia** (Figs. 192–196): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 conspicuous, triangular, posteromesal processes, separated by wide, deep, U-shaped emargination covered basomedially by shelf with its posterior margin concavely produced, when viewed laterally, posterodorsal corner with acute apex of posterior process. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly rectangular in appearance, convex anteriorly, weakly concave posteriorly; when viewed ventrally, weakly concave anteriorly, nearly straight posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, lambda-shaped, strongly elongate, reaching middle of tergum; process “b” sublateral, conspicuous, semiovate, elongate, projected laterad; “head” widely subovate, with anterior apex stout, conspicuously elongate, lateral apices convexly curved, projected anterolaterad, posterior apex small, widely rounded; when viewed laterally, convexly extended mid-dorsally, concavely curved preapicodorsally, “head” wide, subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, narrowest posteriorly; when viewed laterally, ovals elongate at midlength, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, subrectangular, tubularly elongate, shorter (about 0.8 times) and narrower than basal segment, rounded and narrowest posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment stout, subrectangularly elongate, with inner margin weakly sinuous, slightly subovate and narrowest posteriorly, with apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 196).

**Holotype:** Male. **GUATEMALA: Izabal:** Matías de Gálvez, [15° 41' 60" N, 88° 37' W], 14–16.viii.1965, Flint & Ortiz (in alcohol, NMNH).

**Paratypes:** **GUATEMALA: Izabal:** Matías de Gálvez, [15° 41' 60" N, 88° 37' W], 14–16.viii.1965, Flint & Ortiz, 1 male, 1 female (in alcohol, NMNH).

**Etymology:** This new species is named in honor of Rigoberta Menchú Tum, the Guatemalan and Mayan Quiché Indian and winner of the 1992 Nobel Peace Prize, in recognition of her outstanding campaign for human rights, especially for indigenous peoples.

**Distribution:** GUATEMALA: Izabal.

### ***Wormaldia monsonorum* Muñoz-Quesada & Holzenthal, new species**

Figures 233–237.

**Diagnosis.** The singular development of the posterior margin of tergum VIII allows this new species to be easily distinguished from other known species of *Wormaldia*. Tergum VIII has 2 prominent and convexly subtriangular posteromesal projections, separated by a conspicuous, deep, U-shaped, mesal emargination, which is noticeably constricted in its middle and surrounded by a basomesal invagination (Fig. 234).

**Description.** Adult: Length of male forewing 4.0–4.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 253); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 254).

Male genitalia (Figs. 233–237): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterolaterad, having 2 prominent, wide, convexly triangular, posteromesal projections separated by noticeably deep, U-shaped, conspicuously curvedly and narrowed at midlength, posterior emargination, surrounded basomedially by mesodorsal invagination; when viewed laterally, posterodorsal corner with pointed apex of posteromesal projection. Sternum VIII weakly convex posteriorly. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convexly projected anterad, weakly concave posteriorly; when viewed ventrally, shallowly concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, noticeable, Y-shaped, strongly elongate, reaching middle of tergum; process “b” sublateral, conspicuous, obtusely triangular, elongate, sinuously projected laterad; “head” subtriangular, wide, with anterior apex small, subovate, lateral apices subtriangularly projected, posterior apex wide, convexly elongate; when viewed laterally, dorsally extended at midlength, sinuous, narrow, concavely curved preapicodorsally, “head” wide, semicircular, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, ovate; when viewed laterally, subovally elongate at midlength, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, subrectangular, tubularly elongate, shorter (about 0.8 times) and narrower than basal segment, slightly concave and narrowest at midlength, widely rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by moderately deep, U-shaped emargination, each basal segment stout, slightly widest at midlength, with outer margin convexly curved, apical segment tubularly elongate, narrowest and weakly concave at midlength, subovally widened posteriorly, with elongate, apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 237).

**Holotype:** Male. **COSTA RICA: Cartago:** Turrialba, Río Chitaría, route 10, 10 km NW Río Reventazón, 9.920° N, 83.604° W, el. 740 m, 21.iii.1991, Holzenthal, Kjer & Quesada (UMSP).

**Paratypes:** **COSTA RICA: Cartago:** Turrialba, [9° 54' N, 83° 41' W], 26.viii.1972, G. F. & S. Hevel, 1 male (in alcohol, NMNH); **Guanacaste:** Parque Nacional Guanacaste, Estación Maritza, Río Tempisquito. 10.958° N, 85.497° W, el. 550 m, 19–20.vii.1987, Holzenthal, Morse & Clausen, 1 male, 1 female (UMSP); Área de Conservación Guanacaste (ACG), Estación Pitilla, Río Orosí. 10.991° N, 85.428° W, el. 700 m., iii.1994, Fdo. Muñoz-Q., 5 males (in alcohol, INBio); **Limón:** Río Telire & small trib. SE Sureka, 9.554° N, 82.892° W, el. 48 m, 1.ii.1986, Holzenthal, Morse & Fasth, 1 male (NMNH); Quebrada near Roxana, 10° 16' N, 83° 45' W, el. 150 m, 11.x.1992, Fdo. J. Muñoz-Q., 9 males (in INBio: 3 males in alcohol; in NMNH: 3 males in alcohol; in UMSP: 3 males in alcohol).

**Etymology:** This new species is named in honor of Drs. Bjorn Monson and Mrs. Margot Monson, and their family, as a gesture of gratitude for their years of friendship to both the senior and junior author.

**Distribution:** COSTA RICA: Cartago, Guanacaste, Limón.

### ***Wormaldia navarroae* Muñoz-Quesada & Holzenthal, new species**

Figures 228–232.

**Diagnosis.** This new species is closely related to *W. arizonensis* and *W. tarasca*. These 3 species differ from the all other known species of this genus by the unusual shapes of various structures of tergum X and the inferior appendages in combination. Tergum X has process “a” with a prominent lambda-shape and conspicuously elongate, reaching the middle of the tergum (Figs. 217, 222, 229). In addition, segment X has the “head” with a large size and a conspicuous balloon or egg-shape (Figs. 216, 217, 221, 222, 228, 229). Finally, the apical segment

of the inferior appendage is triangular or subtriangular, and strongly narrower and shorter than the basal segment (Figs. 216, 221, 228). In spite of these similarities, *W. navarroae* can be distinguished from the other 2 species by the shapes of tergum VIII, and the superior and inferior appendages. In this new species, tergum VIII has a shallow, wide, and concave emargination posteriorly, but without triangular posteromesal projections and a subdorsal shelf (Fig. 229). When viewed laterally, the superior appendage is strongly and convexly projected at about midlength on its dorsal margin (Fig. 228). When viewed laterally, the apical segment of the inferior appendage is triangular, prominently narrowed and pointed posteriorly (Fig. 228).

**Description.** Adult: Length of male forewing 5–6 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, and small patch of lighter setae over cord and crossvein *m-cu*, with apical forks I, II, III, IV, and V present (as in Fig. 226); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 227).

**Male genitalia** (Figs. 228–232): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with conspicuous, wide, concave, mesal emargination posteriorly; when viewed laterally, margins nearly straight. Sternum VIII with wide, convex projection posteromesally, about 0.3 times length of sternum VIII. Segment IX, when viewed dorsally, widely concave anteriorly; when viewed laterally, slender, nearly subrectangular in appearance, convexly projected anterad, sinuous posteriorly; when viewed ventrally, concave anteriorly, sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, stout, with process “a” anteromedial, conspicuous, wide, lambda-shaped, elongate, reaching middle of tergum; process “b” sublateral, semioval, elongate, projected laterad with tiny spines; “head” conspicuous, wide, rounded; when viewed laterally, acutely produced mid-dorsally, narrow preapically, “head” conspicuously egg-shaped. Superior appendage, when viewed dorsally, parallel with segment X, strongly convexly extended at midlength, slightly pointed apically; when viewed laterally, stout, short, slightly surpassing middle of segment X, strongly convexly projected dorsomesad, rounded apically. Inferior appendage, 2-segmented; when viewed laterally, basal segment thick, subrectangular, elongate, widest and convex at midlength, apical segment stout, triangular, broadest basally, noticeably narrowed posteriorly, markedly shorter (about 0.5 times) and narrower than basal segment, pointed apically; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, V-shaped emargination, each basal segment thick, widest at midlength, with outer margin slightly convexly curved, apical segment nearly triangularly elongate, narrowest and rounded apically, with small, apicolateral patch of short, black, spine-shaped and peg-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 232).

**Holotype:** Male. **MEXICO: Oaxaca:** km 11, carretera Teotitlán-Huautla, [18° 15' N, 97° 02' W], 6.xi.1988, R. Barba (in IBUNAM).

**Paratypes:** **MEXICO: Guerrero:** Ruta 130, Ciudad Altamirano-80 km NO. de Zihuatanejo, [17° 09' N, 101° 07' W], 7.vi.1984, J. Bueno, 1 male (in alcohol, IBUNAM).

**Etymology:** This new species is named in honor of Dr. Sonia Navarro Pérez of the Departamento de Botánica y Zoología at Universidad de Guadalajara (Jalisco, México), as a gesture of thanks for her valuable cooperation, encouragement, and friendship, and in recognition of her valuable contribution to the study and conservation of Mexican biodiversity.

**Distribution:** MEXICO: Guerrero, Oaxaca.

### ***Wormaldia palma* Flint 1991**

Figures. 33–37.

*Wormaldia palma* Flint 1991, 31, figs. 49, 50, male, Colombia: Antioquia (USNM).

**Diagnosis.** This species was placed in the *W. arizonensis* Group of Ross (1949, 1956) by Flint (1991). *Wormaldia palma* is closely related to *W. dorsata*, *W. fredycarol*, *W. isela*, *W. luma*, and *W. maesi*. They can be distinguished from other known species of the genus by the following distinctive characters in combination: 1) segment IX has a nearly hook-shaped projection anterodorsally (best seen laterally, Figs. 7, 11, 18, 23, 28, 33); and 2) tergum X is



stout, nearly triangular, without process “a”, and with the “head” wide, rounded posteriorly, and without lateral apices (Figs. 8, 12, 19, 24, 29, 34). However, *W. palma* differs from these 5 species in the shapes of terga VIII and X. In this species, tergum VIII is nearly convexly projected posterad, with a conspicuous, obtusely triangular, subdorsal pouch (Fig. 34). Tergum X is subtriangularly elongate, narrowed posteriorly, with process “b” developed into a conspicuous spine, and the “head” conspicuous and widely semicircular; when viewed laterally, the “head” is wide and semicircular (Figs. 33–34).

Description. Adult: Length of male forewing 5.5–6.0 mm. Head brown, with brown setae. Antenna long, slender, brown, with small, dark brown and yellowish rings of small setae. Maxillary palps brown, with brown setae. Labial palps brown, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with small patch of light setae over cord and crossvein *m-cu*, and apex of *Cu2*, with apical forks I, II, III, IV, and V present (as in Fig. 16); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 17).

Male genitalia (Figs. 33–37): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII nearly convexly projected posterad with conspicuously wide, obtusely triangular, subdorsal pouch projected anterad; when viewed laterally, slightly concave at midlength. Sternum VIII with posterior margin straight or weakly convex mesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, with weak, hook-shaped projection anterodorsally, with wide, convex projection anteriorly, sinuous posteriorly; when viewed ventrally, concave anteriorly, sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, stout, clearly elongate subtriangularly, narrowed and semicircular posteriorly, with process “a” absent; process “b” sublateral, developed into conspicuous spine, directed anterolaterally; when viewed laterally, sinuous dorsally, narrow and weakly upcurved preapically, “head” noticeably wide, semicircular. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded apically; when viewed laterally, tubularly elongate, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broad at midlength, convex dorsally and ventrally, apical segment stout, rectangular, tubularly elongate, shorter (about 0.8 times) and narrower than basal segment, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/5ths, separated posteromesally by very deep, narrow, U-shaped emargination, each basal segment stout, wider at midlength, with outer margin convexly curved, apical segment tubularly elongate, narrowest and rounded posteriorly, with slightly elongate, apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 37).

**Material examined:** COLOMBIA: COLOMBIA: Antioquia: 10 km E Medellín [road to Las Palmas], 6.ii.1983, O.S. Flint, Jr., 1 male (Holotype, USNM); Valle del Cauca: Municipio El Cerrito, Río Cerrito, 7.1 kms E. Hacienda “El Paraíso”, 3° 38' 59" N, 76° 9' 10" W, el. 1950 m, 3.xii.1997, Fdo. Muñoz-Q. *et al.*, 9 males (in MEA: 5 males; in NMNH: 2 males; in UMSP: 2 males).

**Distribution:** COLOMBIA: Antioquia, Valle del Cauca (new record).

### *Wormaldia paprockevi* Muñoz-Quesada & Holzenthal, new species

Figures 267–273.

Diagnosis. In this new species, tergum VIII has a posteromesal process with a distinctive shape, which easily distinguished it from all other known species of *Wormaldia*. The posteromesal process has a conspicuous and distinctive M-shape (Fig. 267–271).

Description. Adult: Length of male forewing 4.0–4.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 272); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 273).

Male genitalia (Figs. 267–271): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with conspicuous, narrow, M-shaped, posteromesal process; when viewed laterally, posterodorsal corner with

pointed apex of posterior process. Sternum VIII with wide, convex projection posteromesally, about 0.1 times length of sternum VIII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, nearly triangular in appearance, with broad, convex projection anteriorly, straight posteriorly; when viewed ventrally, concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” sublateral, small, nearly semiovate, projected laterad; “head” narrowly small, with anterior apex tiny, semicircular, without lateral apices, posterior apex minute, rounded; when viewed laterally, slender, sinuous dorsally, concavely curved preapicodorsally, “head” nearly hook-shaped. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate; when viewed laterally, tubularly elongate, slightly shorter than segment X, rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment slender, rectangular, tubularly elongate, shorter (about 0.7 times) and narrower than basal segment, rounded and slightly widest posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/5ths, separated posteromesally by deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment stout, tubularly elongate, subovate posteriorly, with elongate, apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 271).

**Holotype:** Male. **COSTA RICA: Puntarenas:** Río Jaba and rock quarry 1.4 km (air) W Las Cruces [San Vito de Jaba], 8.79° N, 82.97° W, el. 1150 m, 9.viii.1990, Holzenthal, Blahnik & Muñoz (UMSP).

**Paratype:** **COSTA RICA: Puntarenas:** Río Jaba and rock quarry 1.4 km (air) W Las Cruces [San Vito de Jaba], 8.79° N, 82.97° W, el. 1150 m, 9.viii.1990, Holzenthal, Blahnik & Muñoz, 1 male (NMNH).

**Etymology:** This new species is named in honor of Dr. Henrique **Paprocki** and his wife **Virgínia** Mendes Braga, as a gesture of gratitude for their appreciable friendship and in recognition of their contribution to the study and conservation of Brazilian aquatic ecosystems.

**Distribution:** COSTA RICA: Puntarenas.

### ***Wormaldia planae* Ross & King 1956**

Figs. 248–254.

*Wormaldia planae* Ross & King, in Ross 1956, 38, 40, 61, 64, figs. 75 A, B, 123 A, B, 130, male, Chiapas, Mexico (INHS); Flint 1968, 9, figs. 10, 11; 1971, 20, figs. 17, 18; 1981, 10, figs. 14, 15; 1991, 31, figs. 47, 48; 1995, 7–8; Fischer 1971, 195; Bueno-Soria & Flint 1978, 194 (distribution); Holzenthal 1988, 58 (distribution); Aguila-S. 1992, 535 (distribution); Botosaneanu 2002, 91 (distribution); Muñoz-Quesada & Holzenthal 2008, 53, figs. 101–107.

*Wormaldia arcopa* Denning, 1966 (in Denning & Sykora 1966), 1219, fig. 1, male, Panama: Barro del Colorado Island (H. Rodney Dodge collection, CAS); Aguila-S. 1992, 535 (distribution). **NEW SYNONYM**

**Diagnosis.** At present, this species and *W. arizonensis* are the only known species in the genus distributed in both the Nearctic and Neotropical Regions (Muñoz-Quesada & Holzenthal 2008). It is the most common and widespread *Wormaldia* species in the New World, and was placed by Ross (1956) in the *W. arizonensis* Group.

In *W. planae*, *W. anhelitus*, and *W. buenorum*, tergum VIII has a U-shaped posteromesal emargination, not covered by a shelf (Figs. 244, 249, 256). However, *W. planae* differs from those 2 species, and other species of *Wormaldia*, by the shapes of tergum VIII and the inferior appendages. In *W. planae*, tergum VIII has 2 conspicuous knob-shaped processes posteromesally (Fig. 249). When viewed laterally, the apical segment of the inferior appendage is subrectangular and rounded posteriorly; when viewed dorsally, it is subovate posteriorly and bears an apicolateral patch of short black setae (Figs. 248, 251).

Some specimens, from different countries, have a noticeable variation in the shapes of elements of terga VIII and X from those of the holotype. The posteromesal emargination and the posteromesal processes of tergum VIII are shallower and smaller respectively. In tergum X, the apices of the “head” are smaller or flattened, and processes “a” and “b” are slightly smaller. However, when these particular morphological variations are considered in the context of other diagnostic features of *W. planae*, as compared to other species of *Wormaldia*, the variation probably remains within the diagnostic definition of this species. The morphological variation presented by these specimens suggests that this species may be particularly subject to ecophenotypic variation.

For this study, we had the opportunity to observe and illustrate the male genitalia of the holotype of *W. arcopa* described by Denning (in Denning & Sykora 1966) from Panama (Figs. 288–291). The comparison of the holotype and subsequent illustrations of *W. arcopa* with those of the holotype and illustrations of *Wormaldia planae* from Mexico (Figs. 248–254), led to the conclusion that *W. arcopa* is a junior synonym of *W. planae*.

**Description.** Adult: Length of male forewing 4.5–5.0 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 253); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 254).

**Male genitalia** (Figs. 248–252): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterolaterad, having 2 stout, elongate, knob-shaped, posteromesal processes separated by broad, deep, U-shaped emargination; when viewed laterally, posterodorsal corner with rounded apex of posterior process. Sternum VIII straight or very weakly convex posteromesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convex anteriorly, weakly sinuous posteriorly; when viewed ventrally, weakly concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, Y-shaped, strongly elongate, reaching middle of tergum; process “b” sublateral, obtusely triangular, elongate, projected laterad; “head” triangular, with anterior apex subovally elongate, lateral apices subovally elongate, posterior apex wide, convexly elongate; when viewed laterally, convexly extended mid-dorsally, concavely curved preapicodorsally, “head” subovally elongate, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout; when viewed laterally, subovally elongate at midlength, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, tubularly elongate, shorter (about 0.8 times) and narrower than basal segment, widely rounded posteriorly; when viewed dorsally, apical segment stout, subrectangularly elongate, subovate posteriorly, with elongate, apicolateral patch of short, thin, black, spine-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by narrow, moderately deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 252).

**Material examined:** **COLOMBIA:** **Antioquia:** Quebrada Honda, 12 km SW Fredonia, el. 1450 m, 22.ii.1983, O. S. Flint, Jr., 2 males, 1 female (NMNH); same except, 3–4.iii.1984, C. M. & O. S. Flint, Jr., 2 males (NMNH); Municipio de Sopetrán, Quebrada La Jiménez, el. 780 m, 2–22.vi.1983, U. Matthias, 1 male (in alcohol, NMNH); **Meta:** Quebrada Blanca, 3 km W Restrepo, 11.ii.1983, O. S. Flint, Jr., 1 male (NMNH); **Valle del Cauca:** Los Tablones, Finca La Florida, el. 1300 m, 7.i.1959, J. F. G. Clarke, 6 males, 1 female (1 male in CNC, 5 males, 1 female in NMNH); same except, Finca La Florida, Tablones, el. 1300 m, i.1959, J. F. G. Clarke, 11 males, 3 females (in alcohol, NMNH). **COSTA RICA:** **Alajuela:** Parque Nacional Rincón de la Vieja, Quebrada Provisión, 10.769° N, 85.281° W, el. 810 m, 4.iii.1986, Holzenthal & Fasth, 1 male (in alcohol, UMSP); San Ramón, Reserva Forestal San Ramón, Río San Lorencito & tribs., 10.216° N, 84.607° W, el. 980 m, 31.iii.–1.iv.1987, Holzenthal, Hamilton & Heyn, 2 males (INBio), same except, 6–10.iii.1991, Holzenthal, Muñoz & Huisman, 1 male (in alcohol, UMSP); [Ciudad Quesada] Río Peje and falls, carretera 1 km SE San Vicente, 10.277° N, 84.388° W, el. 1450 m, 14–15.ii.1992, Holzenthal, Muñoz & Kjer, 6 males (in INBio: 2 males in alcohol; in UMSP: 4 males in alcohol); **Guanacaste:** Quebrada García, 10.6 Km ENE Quebrada Grande, 10.862° N, 85.428° W, el. 470 m, 8.iii.1986, Holzenthal & Fasth, 3 males (in alcohol, UMSP); Parque Nacional Guanacaste, Estación Maritza, Río Tempisque, 10.958° N, 85.497° W, el. 550 m, 19–20.vii.1987, Holzenthal, Morse & Clausen, 7 males, 1 female (in INBio: 2 males in alcohol; in UMSP: 5 males, 1 female in alcohol); same except, 17–18.vi.1988, C. M. & O. S. Flint, Jr., 1 male, 1 female (NMNH); 30–31.viii.1990, Huisman, Blahnik & Quesada, 3 males, 2 females (2 males, 1 female in alcohol INBio); Río Tempisque Sur, 10.95° N, 85.48° W, 30.viii.1990, el. 600 m, Huisman & Quesada, 1 male (in alcohol, UMSP); carretera 0.7 km N Estación Maritza, 10.96° N, 85.50° W, el. 550 m, 31.viii.1990, Huisman & Quesada, 12 males, 1 female (2 males, 1 female in alcohol UMSP); Río Góngora (sulfur mine), 4 km (air) NE Quebrada Grande, 10.887° N, 85.470° W, el. 590 m, 21.vii.1987, Holzenthal, Morse & Clausen, 9 males, 2 females (in alcohol, UMSP); Río Aguacate, 0.5 km E.



Aguacate (Laguna del Arenal), 10.565° N, 84.939° W, el. 590 m, 16.ii.1992, Holzenthal, Muñoz & Kjer, 3 males (2 males in alcohol INBio); **Puntarenas:** Río Singri, carretera 2 km (air) S Finca Helechales, 9.057° N, 83.082° W, el. 720 m, 21.ii.1986, Holzenthal, Morse & Fasth, 2 males, 7 females (in alcohol, UMSP); Río Guineal, carretera 1 km (air) E. Finca Helechales, 9.076° N, 83.092° W, el. 840 m, 22.ii.1986, Holzenthal, Morse & Clausen, 8 males, 4 females (in alcohol, UMSP); Reserva Biológica Carara, Quebrada Bonita, 9.775° N, 84.605° W, el. 35 m, 18–20.v.1990, Holzenthal & Blahnik, 1 male (UMSP); same except, 11.iii.1991, Holzenthal, Muñoz & Huisman, 1 male (INBio); Río Jaba and rock quarry 1.4 km (air) W Las Cruces [San Vito de Jaba], 8.79° N, 82.97° W, el. 1150 m, 9.viii.1990, Holzenthal, Blahnik & Muñoz, 2 males, 1 female (UMSP); Río Cotón in Las Alturas, 8.938° N, 82.826° W, el. 1360 m, 12.viii.1990, Holzenthal, Blahnik & Muñoz, 3 males (2 males in alcohol INBio); same except, small spring seep to Río Cotón in Las Alturas, 8.939° N, 82.824° W, el. 1380 m, 14.viii.1990, Holzenthal, Blahnik & Muñoz, 4 males, 2 females (in alcohol, UMSP); Jardín Botánico R. & C. Wilson, trib. along Sendero del Agua, 8.80° N, 82.96° W, el. 1180 m, 8.viii.1990, Holzenthal, Blahnik & Muñoz, 3 males (in alcohol, UMSP); Península de Osa, Rincón de Osa, Boscosa, Quebrada Aguabuena, 17.ix.1991, Fdo. Muñoz, 1 male (in alcohol, INBio); Península de Nicoya, Reserva Biológica Cabo Blanco, Quebrada San Miguel, Estación San Miguel, el. 40 m, 10–14.xi.1991, F. A. Quesada, 12 males, 13 females (INBio); Corcovado, Estación Sirena, [8° 33' 59" N, 83° 35' 59" W], 5–7.iv.1981, J. Bueno, 1 male (in alcohol, IBUNAM); **San José:** Santiago de Puriscal, Desamparaditos, Quebrada Máquina, el. 800 m, x.1990, E. Quesada, 1 male (INBio); Parque Nacional Braulio Carrillo, Estación Carrillo, Quebrada Sanguijuela, 10.160° N, 83.963° W, el. 800, 27.iii.1987, Holzenthal, Hamilton & Heyn, 1 male (in alcohol, UMSP). **ECUADOR: Los Ríos:** Quevedo 56 km N Río Palenque Biological Station, el. 250 m, 28–29.vii.1976, Jeffrey Cohen, 1 male (in alcohol, NMNH); **Pichincha:** Santo Domingo de los Colorados, 14 km E., 5.vii.1975, Langley & Cohen, 1 male (in alcohol, NMNH); same except, 47 km S, 29.vii.1976, Jeffrey Cohen, 1 male (in alcohol, NMNH); Forestry Station Maquipucuna, Río Umachaca, el. 1250 m, 4–5.ix.1990, O.S. Flint, Jr., 1 male (NMNH). **GUAYANA:** St. George, 1 km E. Vendome, 12° 04.8' N, 61° 42.2' W, 17.ix.1996, O. S. Flint, Jr., 4 males, 4 females (NMNH); St. George, Annandale Estate, 12° 05.5' N, 61° 42.8' W, 18.ix.1996, O. S. Flint, Jr., 3 males (NMNH). **GUATEMALA: Baja Verapaz:** Ruta 5, km 156, Puente las Burras, 22–24.vi.1966, Flint & Ortiz, 1 male (NMNH). **GUYANA:** Kumu, 25 km SE Lethen, 3° 15.9' N, 59° 43.6' W, 4–5.iv.1994, O. S. Flint, Jr., 12 males (6 males in alcohol NMNH); **MEXICO: Chiapas:** Finca Maravillas, 16.xii.1931, A. Dampf, 1 male (Paratype MF 8861 in alcohol, INHS); Finca Vergel., 11.v.1935, A. Dampf, 1 male (Paratype MF 4123 in alcohol, INHS); same except, 19.v.1935, A. Dampf, 1 male (Holotype MF 4206 in alcohol, INHS); 1 male (Paratype MF 4207 in alcohol, INHS); 21.v.1935, 1 male (Paratype MF 4239 in alcohol, INHS); 7.8 mi [12.5 km] E. Pichucalco, 7.xii.1975, C. M. & O. S. Flint, Jr., 1 male (in alcohol, NMNH); Pichucalco, [17° 34' N, 93° 07' W], 7.xii.1975, J. Bueno, 1 male (in alcohol, IBUNAM); Colón (Lagartero), Ruta 190, San Cristóbal de las Casas-Ciudad Cuahutemoc, [15° 5' N, 91° 55' W], 6.iv.1974, J. Bueno, 2 males (in alcohol, IBUNAM); **Guerrero:** Ruta 130, Ciudad Altamirano-80 kms NO. de Zihuatanejo, [17° 09' N, 101° 07' W], el. 1200 m, 7.vi.1984, J. Bueno, 10 males, 2 females (in alcohol, IBUNAM); same except, Ciudad Altamirano-Zihuatanejo, km 102, el. 1300 m, 22.vi.1990, J. Bueno, 1 male (in alcohol, IBUNAM); **Michoacán:** Pedernales, Arroyo Frío, [18° 47' N, 103° 01' W], 19.ix.1987, R. Barba, 1 male (in alcohol, IBUNAM); **Oaxaca:** km 10, Guelatao, [17° 18' N, 96° 29' W], el. 1800 m, 19.x.1978, 1 male (in alcohol, IBUNAM); Loxicha, Ruta 175, Oaxaca-Puerto Ángel, [16° N, 96° 50' W], el. 450 m, 22.x.1982, 6 males, 2 females (in alcohol, IBUNAM); San Mateo Yetla, Ruta 175, km 5 Valle Nacional-Oaxaca, [17° 45' N, 96° 24' W], 14.x.1990, E. Ramírez & E. Barrera, 1 male (in alcohol, IBUNAM); **Tabasco:** Palenque, Río Chacamax, 6.xii.1975, C. M. & O. S. Flint, Jr., 1 male (in alcohol, NMNH); **Veracruz:** Las Cabañas, near Sontecomapan, [18° 30' N, 95° 10' W], 4–5.xii.1975, C. M. & O. S. Flint, Jr., 4 males, 1 female (NMNH); Los Tuxtlas, Biological Station area, seeps at cabañas, [18° 50' N, 95° 10' W], 4.iii.1975, J. Bueno, 2 males, 1 female (IBUNAM); same except, 27.iii.1976, J. Bueno, 8 males (in alcohol, IBUNAM); 21.ii.1985, Velasco & Arias, 3 males (in alcohol, IBUNAM); 8–15.v.1981, C. M. & O.S. Flint, Jr., 17 males, 3 females (5 males in alcohol NMNH); Balzapote, Ruta Catemaco-Montepio, [18° 55' N, 95° 11' W], 28.iii.1976, J. Bueno, 12 males, 6 females (in alcohol, IBUNAM); same except, 18.ii.1977, J. Bueno, 1 male (in alcohol, IBUNAM); 8.ix.1977, J. Bueno, 1 male (in alcohol, IBUNAM); 14.vi.1978, J. Bueno, 1 male (in alcohol, IBUNAM). **NICARAGUA: Carazo:** Quebrada on farm California, 45 km SW of Managua towards Pochomil Montelimar, 11° 55.625' N, 86° 27.717' W, el. 185 m, 15.viii.2001, Chamorro & Lacayo, 1 male (in alcohol, MEL); **Esteli:** Miraflores Natural Reserve, Quebrada Grande, 13° 13.327' N, 86° 15.557' W, el. 1200 m, 19.vii.2000, Chamorro & Lacayo, 6 males, 14 females (in alcohol, MEL); same except, Quebrada Grande, below waterfall, 13°



12.677' N, 86° 15.940' W, el. 1230 m, 20.vii.2000, Chamorro & Lacayo, 1 male, 4 females (in alcohol, MEL); **Jinotega:** Cerro Mazú, 14° 33' N., 85° 07' W, el. 220 m; 7–10.ix.1997, J. M. Maes & B. Hernández, 14 males (in alcohol, MEL); Área Protegida Dantanli-El Diablo, La Quebradona, 1 km NE de Santa Maura, 13° 10.389' N, 85° 51.404' W, el. 1050 m, 29.vii.2000, Chamorro & Lacayo, 6 males (in alcohol, MEL); **Matagalpa:** El Coyolar, 50 km E. Matagalpa, vii.1991, S. Hue, 8 males, 3 females (in alcohol, NMNH); same except, 20.viii.1991, S. Hue, 8 males, 3 females (in alcohol, NMNH); **Zelaya:** Cerro Saslaya, 13° 44' N, 85° 01' W, iv.1996, J. M. Maes & B. Hernández, 1 male (in alcohol, NMNH); Río Latas, 14° 04' N, 88° 33' W, el. 220 m, 2.vi.1998, J. M. Maes & B. Hernández, 2 males (in alcohol, MEL). **PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 17.v.–25.vii.1978, H. Wolda, 1 male (in alcohol, NMNH); same except, 20.ix.–12.xii.1978, H. Wolda, 2 males (in alcohol, NMNH); 14–27.iii.1979, H. Wolda, 1 male (in alcohol, NMNH); 30.v.–26.vi.1979, H. Wolda, 1 male (in alcohol, NMNH); Panama: Isla Taboga, 13.vi.[19]11, August Busck, 1 male (NMNH); Cerro Campana, [8° 40' 60" N, 79° 55' W], 11–14.vii.1967, O. S. Flint, Jr., 1 male (NMNH); Barro Colorado Island, [9° 8' 59" N, 79° 50' 59" W], 12.iii.1967, M. E. Irwin, 6 males, 6 females (in alcohol, NMNH); same except, Snyder-Molino Trail, 2.ix.–6.x.1987, H. Wolda, 18 males, 2 females (in alcohol, NMNH); Snyder-Molino Trail, 6.vii.–2.viii.1988, H. Wolda, 5 males, 2 females (in alcohol, NMNH); Snyder-Molino Trail, 31.viii.–4.x.1988, H. Wolda, 12 males, 9 females (in alcohol, NMNH); Snyder-Molino Trail, 12.x.–1.xi.1988, H. Wolda, 19 males, 7 females (in alcohol, NMNH); Snyder-Molino Trail, 3.–30.viii.1988, H. Wolda, 13 males, 4 females (in alcohol, NMNH); Snyder-Molino Trail, 2.xi.–27.xii.1988, H. Wolda, 13 males, 4 females (in alcohol, NMNH); Snyder-Molino Trail, 1.xi.–12.xii.1989, H. Wolda, 7 males, 1 female (in alcohol, NMNH); Snyder-Molino Trail, 18.vii.–11.ix.1990, H. Wolda, 17 males, 6 females (in alcohol, NMNH); Snyder-Molino Trail, 19.ix.–30.x.1990, H. Wolda, 15 males, 3 females (in alcohol, NMNH); Snyder-Molino Trail, 7.xi.–18.xii.1990, H. Wolda, 9 males, 2 females (in alcohol, NMNH). **TOBAGO: St. John Province:** Hermitage River Bridge, Charlottville, [11° 19' N, 60° 32' 60" W], 12–21.iii.1979, D. Hardy & W. Rowe, 5 males, 7 females (in alcohol, NMNH); same except, 14–21.iii.1979, D. Hardy & W. Rowe, 3 males, 4 females (2 males, 4 females in alcohol NMNH); Charlottville 5 km S, 11° 19' N, 60° 34' W, 10–11.vi.1993, O. S. Flint & N. E. Adams, 6 males, 2 females (NMNH); St. Paul Roxborough, 6 km NNW, 11° 16' N, 60° 35' W, 20.iv.1994, Wayne N. Mathis, 1 male (NMNH); same except, 6.5 km N, B1/5, 11° 17' N, 60° 35' W, el. 390 m, 15–16.vi.1993, O. S. Flint, Jr., 3 males, 1 female (NMNH). **TRINIDAD:** Simla, Arima Valley, [10° 37' N, 61° 16' W], S. S. & W. D. Duckworth, 1 male, 1 female (NMNH); Mount St. Benedict stream, 10° 39' N, 61° 24' W, el. 250 m, 20–25.vi.1993, O. S. Flint & N. E. Adams, 10 males, 6 females (NMNH). **VENEZUELA: Aragua:** Río El Limón, fish hatchery, Maracay, [10° 18' N, 67° 38' W] 22–23.x.1974, F. H. Weibezahn, 6 males, 3 females (in alcohol, NMNH); same except, 4–5.xii.1974, F. H. Weibezahn, 2 males, 1 female (in alcohol, NMNH); 3–4.vi.1975, F. H. Weibezahn, 2 males, 1 female (in alcohol, NMNH); 12–18.vi.1975, F. H. Weibezahn, 1 male (in alcohol, NMNH); 1–2.vii.1975, F. H. Weibezahn, 1 male (in alcohol, NMNH); 15–16.vii.1975, F. H. Weibezahn, 1 male, 1 female (in alcohol, NMNH); 12.viii.1975, F. H. Weibezahn, 3 males (in alcohol, NMNH); 3–6.ii.1976, C. M. & O. S. Flint, Jr., 1 male, 1 female (in alcohol, NMNH); 24.i.–2.ii.1983, O. S. Flint, Jr., 2 males (in alcohol, NMNH); Estación Experimental Cataurito, carretera 32 km E. Villa de Cura, [10° 1' 59" N, 67° 28' 59" W], el. 1100 m, 1.ii.1983, O. S. Flint, Jr., 4 males (NMNH); 1 km S Rancho Grande, 5.ii.1976, C. M. & O. S. Flint, Jr., 3 males (NMNH); 1 km E. Estación Biológica Rancho Grande, 10.352° N, 67.680° W, el. 1100 m, 27.i.1994, Holzenthal, Cressa & Rincón, 5 males (UMSP); **Barinas:** Parque Nacional Sierra Nevada, Quebrada San Juan in Station Rosa, 8° 27.87' N, 70° 50.92' W, 21.iii.1997, el. 1000 m, Holzenthal, 1 male (UMSP); **Falcón:** Parque Nacional Sierra de San Luis, cataratas del Río Hueque, 11° 10.708' N, 69° 33.732' W, el. 583 m, 6.vi.2001, Holzenthal, Blahnik, Paprocki & Cressa, 1 male (UMSP); Río Mitare, near San Luis, 11° 07.930' N, 69° 39.184' W, el. 589 m, 7.vi.2001, Holzenthal, Blahnik, Paprocki & Cressa, 6 males (UMSP); Parque Nacional Cueva de la Quebrada del Toro, Quebrada Toro, 10° 49.581' N, 69° 07.990' W, el. 530 m, 11.vi.2001, Holzenthal, Blahnik, Paprocki & Cressa, 4 males, 2 females (UMSP); **Lara:** Parque Nacional Terepaima, Río Sarare, near Sarare, 9° 49.036' N, 69° 11.596' W, el. 357 m, 15.vi.2001, Holzenthal, Blahnik, Paprocki & Cressa, 2 males (UMSP); same except, Río Auro, near Sabana Alta, 9° 44.740' N, 69° 16.614' W, el. 480 m, 16.vi.2001, Holzenthal, Blahnik, Paprocki & Cressa, 6 males, 1 female (UMSP); Quebrada San Antonio, 9° 51.754' N, 69° 13.098' W, el. 631 m, 17.vi.2001, Holzenthal, Blahnik, Paprocki & Cressa, 7 males, 1 female (UMSP); Quebrada Los Frailes, 8.3 km from San Pedro, 9° 48.358' N, 70° 05.297' W, el. 1892 m, 23.vi.2001, Holzenthal, Blahnik, Paprocki & Cressa, 1 male, 1 female (UMSP); **Merida:** Río Montalbán, Ruta 4, 19 km W. Mérida, [8° 35' N, 71° 8' W], 20.ii.1976, C. M. & O. S. Flint, Jr., 1 male (NMNH); **Sucre:** Parque Nacional Península de Paira, Urique, Río la Viuda, 10°

42.830' N, 61° 57.661' W, el. 15 m, 30.iii.1995, Holzenthal, Flint & Cressa, 21 males, 6 females (UMSP); same except, Puerto Viejo, Río El Pozo, 10° 43.073' N, 62° 28.569' W, el. 20 m, 30.iv.1995, Holzenthal, Flint & Cressa, 1 male, 4 females (UMSP).

**Distribution:** BRAZIL: northern; COLOMBIA: Antioquia, Meta, Risaralda, Valle del Cauca; COSTA RICA: Alajuela, Guanacaste, Puntarenas, San José; DOMINICA; ECUADOR: Los Ríos, Pichincha; GRENADA; GUATEMALA: Baja Verapaz; GUYANA (**new record**); MEXICO: Chiapas, Guerrero (**new record**), Michoacán (**new record**), Oaxaca (**new record**), Tabasco, Veracruz; NICARAGUA: Carazo, Estelí, Jinotega, Matagalpa, Zelaya; PANAMA: Chiriqui, Panama; ST. VINCENT; TOBAGO; TRINIDAD; VENEZUELA: Aragua, Barinas, Falcón, Lara, Isla Margarita, Merida, Sucre; USA: Arizona.

### ***Wormaldia prolixa* Flint 1991**

Figures 114–120.

*Wormaldia prolixa* Flint 1991, 31, figs. 51, 52, male, Colombia: Antioquia (NMNH).

Diagnosis. Flint (1991) placed this species in the *W. arizonensis* Group of Ross (1949, 1956). *Wormaldia prolixa*, together with *W. andrea* and *W. gallardoi*, are easily distinguished from other known species of this genus by the following diagnostic characters in combination: 1) segment IX has a conspicuous, elongate, and strongly acute projection anteriorly (Figs. 104, 109, 114); 2) the “head” of tergum X is convexly subtriangular and with its anterior apex subtriangularly widened (Figs. 105, 110, 115); and 3) the apical segment of the inferior appendage is noticeably longer than the basal segment (Figs. 104, 109, 114). However, *W. prolixa* can be distinguished from those 2 species by the following distinctive features: 1) posterior margin of tergum VIII with a wide, deep, U-shaped, mesal emargination covered by a sinuously concave basal shelf, with 2 knob-shaped lateral processes, (Fig. 115); and 2) tergum X with process “a” conspicuously lambda-shaped, convexly curved at midlength, slightly elongate (barely reaching the middle of tergum), and with process “b” triangular and slightly elongate (Fig. 115). The distinctive features of the other 2 species are described in their respective diagnoses.

The presence of *W. prolixa* was reported in Costa Rica, Panama, and Colombia by Flint (1991) and Flint *et al.* (1999). All available specimens from those countries were examined for this monograph. Those from Costa Rica and Panama proved to be *W. gallardoi*. Consequently, the distribution of *W. prolixa* is restricted to Colombia.

Description. Adult: Length of male forewing 5.0–5.5 mm. Head brown, with yellowish and brown setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps brown, with brown setae. Labial palps brown, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 119); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 120).

Male genitalia (Figs. 114–118): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected laterad with 2 stout, knob-shaped, posteromesal processes separated by deep, wide, U-shaped emargination covered basomedially by concave shelf; when viewed laterally, posterodorsal corner with subovate apex of posterior process. Sternum VIII weakly projected convexly posteromesad, less than 0.1 times length of sternum VIII. Segment IX, when viewed dorsally, deeply concave anteriorly; when viewed laterally, broad, triangular in appearance, with strongly elongate, acute projection anteriorly, weakly concave posteriorly; when viewed ventrally, concave anteriorly, slightly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, conspicuous, lambda-shaped, convexly curved, wide at midlength, slightly elongate, barely reaching middle of tergum; process “b” sublateral, triangular, slightly elongate, projected laterad; “head” wide, convexly triangular, with anterior apex subtriangularly widened, lateral apices subtriangularly projected, posterior apex wide, convex; when viewed laterally, slender, sinuous dorsally, concavely curved preapicodorsally, “head” subtriangular, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, tubular, rounded apically; when viewed laterally, stout, slightly elongate tubularly, shorter than segment X, weakly curved at midlength, widely rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, strongly elongate tubularly, longer (about 1.4 times)

and narrower than basal segment, subovally rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by moderately deep, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment nearly subtubularly elongate, with inner margin slightly concave bearing short, black, small, spine-shaped and peg-shaped setae on mesal surface. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 118).

**Material examined:** COLOMBIA: **Antioquia:** 12 km E Medellín [road to Santa Elena], 6.ii.1983, O.S. Flint, Jr., 1 male (Holotype, USNM); **Risaralda:** 4 km E Santa Rosa de Cabal, 29.ii.1984, C.M. & O.S. Flint, Jr., 1 male (NMNH); **Valle del Cauca:** Municipio El Cerrito, Río Cerrito, 7 km E. Hacienda “El Paraíso”, 3° 38' 59" N, 78° 9' 10" W., el. 1950 m, 3.xii.1997, Fdo. Muñoz *et al.*, 4 males (in MEA: 3 males; in UMSP: 1 male).

**Distribution:** COLOMBIA: Antioquia, Risaralda (**new record**), Valle del Cauca (**new record**).

### ***Wormaldia savoriorum* Muñoz-Quesada & Holzenthal, new species**

Figures 177–181.

**Diagnosis.** Among the known species of *Wormaldia*, this new species, *W. bolivari* and *W. zunigae*, new species, are distinguished by distinctive features of tergum VIII and the inferior appendages. In these 3 species, tergum VIII has the posterior margin with a mesal shelf with its posterior margin smoothly concave (Figs. 168, 178, 183). The apical segment of the inferior appendage is noticeably shorter than the basal segment (Figs. 167, 177, 182). *Wormaldia savoriorum* can be distinguished from the other 2 species by particular features of terga VIII and X. In this new species, tergum VIII has 2 conspicuous, triangular, posteromesal processes separated by a wide, moderately deep, U-shaped emargination and covered basomedially by a smooth, sinuously concave shelf (Fig. 178). Tergum X has process “a” lambda-shaped and strongly elongate, process “b” medial, triangular and strongly elongate, and the “head” narrowly subtriangular, with its anterior apex small and semicircular (Fig. 178). When viewed laterally, the apical segment of the inferior appendage is rectangularly elongate, slightly concave in its middle, and roundly widened posteriorly (Fig. 177).

**Description.** Adult: Length of male forewing 6 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 165); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 166).

**Male genitalia** (Figs. 177–181): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 stout, triangular, posteromesal processes separated by wide, moderately deep, U-shaped emargination covered basomedially by smooth, sinuously concave shelf; when viewed laterally, posterior margin weakly concave, with knob-shaped apex of posterodorsal process. Sternum VIII straight posteriorly without mesal projection or process. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convex anteriorly, straight posteriorly; when viewed ventrally, concave anteriorly, weakly sinuous posteriorly with very shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, lambda-shaped, strongly elongate, reaching middle of tergum; process “b” sublateral, triangular, elongate, projected laterad; “head” narrowly subtriangular, with anterior apex small, semicircular, lateral apices small, convexly projected, posterior apex convex; when viewed laterally, stout, dorsally convex at midlength, concavely curved preapicodorsally, “head” wide, semicircular, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate; when viewed laterally, strongly elongate ovally, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangularly elongate, shorter (about 0.8 times) and narrower than basal segment, weakly concave and narrowest medially, roundly widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 4/5ths, separated posteromesally by shallow, wide, U-shaped emargination, each basal segment thick, widest at midlength,

with outer margin convexly curved, apical segment stout, tubularly elongate, slightly concave and narrowest at midlength, subovally widened posteriorly, with apical patch of short, thin, black, small, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 181).

**Holotype:** Male. **PANAMA: Chiriqui:** Guadalupe Arriba, 8° 52' 26" N, 82° 33' 13" W., 1–27.iii.1984, H. Wolda (in alcohol, NMNH).

**Paratypes:** **PANAMA: Chiriqui:** Guadalupe Arriba, 8° 52' 26" N, 82° 33' 13" W., 1–27.iii.1984, H. Wolda, 3 males, 3 females (in NMNH: 1 male, 2 females in alcohol; in UMSP: 2 males, 1 female in alcohol); same except, 9–22.x.1985, H. Wolda, 2 males (in alcohol, NMNH); 4–31.i.1984, H. Wolda, 4 males, 3 females (in alcohol, NMNH).

**Etymology:** This new species is named in honor of Drs. Rodolfo and Vicky Saborío and their family, as a gesture of gratitude by the senior author.

**Distribution:** PANAMA: Chiriqui.

### ***Wormaldia tarasca* Bueno-Soria & Holzenthal 1986**

Figs. 216–220.

*Wormaldia tarasca* Bueno-Soria & Holzenthal 1986, 139, figs. 4, 6, male, México: Michoacán (IBUNAM).

Diagnosis. Bueno-Soria & Holzenthal (1986) placed this species in the *W. arizonensis* Group of Ross (1949, 1956). *Wormaldia tarasca*, *W. arizonensis* and *W. navarroae* are distinguished from all other known species of *Wormaldia* by sharing the following distinctive characteristics in combination: 1) process “a” of tergum X conspicuously large and with a prominent lambda-shape,, reaching the middle of tergum (Figs. 217, 222, 229); 2) apex of segment X large and conspicuously balloon or egg-shaped (Figs. 216, 217, 221, 222, 228, 229); and 3) apical segment of the inferior appendage triangular or subtriangular, as well as markedly narrower and shorter than the basal segment (Figs. 216, 221, 228). *Wormaldia tarasca* can be distinguished from those 2 species by the shape of the posterior margin of tergum VIII, as well as by the shapes of the superior and the inferior appendages.

In this species, tergum VIII possesses a wide, noticeably deep, and U-shaped emargination posteriorly, with a concave and subdorsal shelf mesally, but without subtriangular posteromesal processes (Figs. 217). When viewed laterally, the superior appendage is digitate and relatively uniform in width (Figs. 216). When viewed laterally, the apical segment of the inferior appendage is slightly narrower, subtriangular, and subtruncately rounded posteriorly (Figs. 216).

Description. Adult: Length of male forewing 6.5–7.0 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 226); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 227).

Male genitalia (Figs. 216–220): Sternum VII with slight, convex projection posteromesally, about 0.1 times length of sternum VIII. Tergum VIII clearly projected posterolaterad with prominently wide, deep, U-shaped, posterior emargination bearing concave, subdorsal shelf mesally; when viewed laterally, posterior margin concave at midlength, convexly projected dorsad. Sternum VIII straight or very weakly convex posteromesally. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly triangular in appearance, with strongly elongate, wide, convex projection anteriorly, weakly concave posteroventrally; when viewed ventrally, concave anteriorly, sinuous posteriorly with narrow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, stout, with process “a” anteromedial, prominent, strongly wide, sinuously lambda-shaped, extremely elongate, surpassing middle of tergum; process “b” developed into several tiny and sublateral spines; “head” prominent, markedly widely rounded; when viewed laterally, convexly produced mid-dorsally, “head” conspicuous, widely ovate. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, bulged at midlength, rounded apically; when viewed laterally, elongate, bulged posteriorly, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate,



noticeably broadest and convex at midlength, apical segment stout, nearly subtriangular, elongate, shorter (about 0.7 times) and narrower than basal segment, slightly rounded and narrowest posteriorly; when viewed dorsally, apical segment stout, with inner margin concave at midlength, roundly widened posteriorly, bearing an elongate, apical patch of short, black, spine-shaped and peg-shaped setae; when viewed ventrally, basal segments fused, united for about their anterior halves, separated posteromesally by deep, V-shaped emargination, each basal segment thick, widest at midlength, with outer margin slightly curved convexly, apical segment as when viewed dorsally. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with various visible, internal sclerites (Fig. 220).

Material examined: **MEXICO: Edo. de Mexico:** desviación Calpulmanca, [18° 55' N, 99° 56' W], 29.v.1987, S. Stanford, 1 male (IBUNAM); Parque Nacional Lagunas de Zempoala: 5<sup>a</sup>. “Laguna Quila”, 19° 07' N, 99° 09' W, 9.vi.1978, Bueno, 1 male (IBUNAM); **Michoacán:** Coalcomán (La Nieve), [18° 46' N, 103° 9' W, el. 1058 m], 19.vii.1983, E. Barrera & M. García, 1 male (Holotype, IBUNAM); **Oaxaca:** Portillo del Rayo, [Ruta 175, Oaxaca-Puerto Angel, 16° 06' N, 96° 28' W], el. 1300 m, 1.xii.1982, M. García & A. Ibarra, 11 males (in IBUNAM: 7 males in alcohol; in NMNH: 2 males in alcohol; in UMSP: 2 males in alcohol); Ruta 175 Oaxaca-Puerto Angel, km 168, 15° 75' N, 96° 25' W, 20.ix.1985, E. Barrera & E. Mariño, 1 male (in alcohol, IBUNAM); km 11 carretera Teotitlán-Huautla, 18° 15' N, 97° 02' W, 6.xi.1988, R. Barba, 1 male, 1 female (IBUNAM); **Puebla:** Puente Viejo a 30 km Zacatlán, 20° 13' N, 97° 66' W, 2.v.1987, J. Bueno, 1 male (in alcohol, IBUNAM); same except, a 20 km de Zacatlán, 20° 19' N, 97° 47' W, 2.v.1987, J. Bueno, 2 males (IBUNAM); km 25 carretera Cuetzalán-Zacatlán, Río Apulco, 19° 75' N, 97° 42' W, 18.iii.1987, J. Bueno, 7 males, 2 females (IBUNAM); same except, 1.v.1987, Bueno, 1 male (IBUNAM); **Veracruz:** Río Jamapa, Ruta Fortín de las Flores-Coscomatepec, a 6 km de Coscomatepec. 19° 09' N, 97° 01' W, 5.v.1981, J. Bueno, 1 male (in alcohol, IBUNAM).

**Distribution:** MEXICO: Edo. de Mexico (**new record**), Michoacán, Oaxaca (**new record**), Puebla (**new record**), Veracruz (**new record**).

### ***Wormaldia tocajoma* Muñoz-Quesada & Holzenthal, new species**

Figures 260–266.

**Diagnosis.** This new species is distinguished from other known species of this genus by the following combination of features: 1) tergum VIII having a deep, U-shaped posteromesal emargination, not flanked by conspicuous processes and not covered by a shelf (Fig. 261); 2) segment X strongly elongate and noticeable narrow apically (Fig. 261); and 3) inferior appendage with the apical segment rectangular, conspicuously tubularly elongate (Fig. 260).

**Description.** Adult: Length of male forewing 4.5–5.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 265); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 266).

**Male genitalia** (Figs. 260–264): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII having deep, wide, U-shaped, posteromesal emargination surrounded basomedially by very tiny spines; when viewed laterally, posterior margin slightly concave. Sternum VIII straight or very weakly convex posteriorly. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, nearly subrectangular in appearance, convexly projected anterad, straight posteriorly; when viewed ventrally, concave anteriorly, very weakly convex posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, inverted U-shaped, visible but very light; process “b” sublateral, nearly semicircular, projected laterad; “head” flattened, anterior apex tiny, semicircularly, lateral apices tiny, convexly subtriangular, projected laterad, posterior apex small, widely rounded; when viewed laterally, slender, dorsally finely sinuous at midlength, “head” semicircular with anterior apex small, projected dorsad, lateral apex small. Superior appendage digitate; when viewed dorsally, parallel with segment X, slender, rounded apically; when viewed laterally, tubularly elongate, shorter than segment X, rounded apically. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical

segment slender, rectangular, tubularly elongate, shorter (about 0.85 times) and narrower than basal segment, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior one-third, separated posteromesally by very deep, V-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment tubularly elongate, weakly incurved at midlength, rounded posteriorly, with small, apicolateral patch of short, thin, black, small, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 3 visible, internal sclerites (Fig. 264).

**Holotype:** Male. **COSTA RICA: Cartago:** Reserva Tapanti, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 9–10.v.1990, Holzenthal & Blahnik (UMSP).

**Paratypes:** **COSTA RICA: Alajuela:** Quebrada Virgencita, 10.2 km S Bajos del Toro, 10.168° N, 84.326° W, el. 1780 m, 5–6.ix.1990, Holzenthal, Blahnik & Huisman, 1 male (UMSP); **Cartago:** Reserva Tapanti, Río Grande de Orosí, 9.686° N, 83.756° W, el. 1650 m, 8–9.vii.1986, Holzenthal, Heyn & Armitage, 2 males (NMNH); same except, Quebrada Segunda @ administrative building, and falls, 9.761° N, 83.787° W, el. 1250 m, 9–10.v.1990, Holzenthal & Blahnik, 1 male (in alcohol, NMNH); same except, 10–13.ix.1991, F. Muñoz & F. A. Quesada, 1 male (NMNH); same except, water fall ca. 1 km (road) NW tunnel, 9.69° N, 83.76° W, 2–3.viii.1990, el. 1600 m, Holzenthal, Blahnik & Muñoz, 2 males, 5 females (UMSP); Tapanti, Quebrada Salto, 12.ix.1991, Fdo. Muñoz & F. A. Quesada, 1 male (NMNH), same except, 10.ii.1994, Fdo. J. Muñoz-Q., 1 male (in alcohol, INBio).

**Etymology:** This new species is named in honor of the family Gómez-Granados, **Tobias, Carmen, José** Alberto, and Ana **María**, as a gesture of gratitude on behalf of the senior author.

**Distribution:** COSTA RICA: Alajuela, Cartago.

### ***Wormaldia trondi* Muñoz-Quesada & Holzenthal, new species**

Figures 211–215.

**Diagnosis.** This new species, together with *W. calderonae* and *W. menchucae*, are distinguished from other species of this genus by the shape of tergum VIII. The posterior margin of tergum VIII has a posteromesal shelf produced sublaterally, and possessing 2 conspicuous, elongate, horn-like or digitate processes (Figs. 193, 207, 212). *Wormaldia trondi* can be distinguished from the other 2 species by the following distinctive features in combination: 1) tergum VIII with 2 conspicuous, knob-shaped, posteromesal processes bordering a mesal shelf with 2 stout, acutely elongate processes, which are separated by a narrow, deep, U-shaped emargination (Fig. 212); and 2) tergum X with process “a” conspicuous, cordate, with the “head” widely semicircular and with its anterior apex small and convexly wide (Fig. 212).

**Description.** Adult: Length of male forewing 4.5–5.0 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 197); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 190).

**Male genitalia** (Figs. 211–215): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 stout, elongate, knob-shaped, posteromesal processes followed by wide, deep, U-shaped emargination covered basomedially by shelf with 2 conspicuous, acutely elongate processes separated by narrow, deep, U-shaped emargination; when viewed laterally, posterodorsal corner with apices of posterior processes. Sternum VIII with wide, weak, convex, posteromesal projection, about 0.1 times length of sternum VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly triangular in appearance, with broad, slightly elongate, convex projection anteriorly, slightly concave posteriorly; when viewed ventrally, concave anteriorly, weakly sinuous posteriorly with very shallow concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromesal, conspicuous, cordate, elongate, nearly reaching lower middle of tergum; process “b” lateral on lower middle, convexly triangular, elongate, projected laterad; “head” wide, semicircular posteriorly, with anterior apex small, wide, convex; when viewed laterally, convexly expanded mid-dorsally, concavely curved preapicodorsally, “head” narrow and subovally elongate. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate at

midlength; when viewed laterally, slender, tubularly elongate, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, elongate, shorter (about 0.9 times) and narrower than basal segment, weakly concave at midlength, roundly widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by wide, moderately deep, U-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment stout, subtriangularly elongate, subovally narrowed posteriorly, with elongate, apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 215).

**Holotype:** Male. **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 2–4.vii.1986, Holzenthal, Heyn & Armitage (UMSP).

**Paratypes:** **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito and tribs., 10.216° N, 84.607° W, el. 980 m, 2–4.vii.1986, Holzenthal, Heyn & Armitage, 1 male (NMNH); same except, 24–27.ii.1987, I. & A. Chacón, 1 male (INBio); 30.iii.–1.iv.1987, Holzenthal, Hamilton & Heyn, 2 males (1 male in alcohol UMSP); 5–9.vii.1987, I. & A. Chacón, 1 male (UMSP); 13–16.vi.1988, C. M. & O. S. Flint, Jr., & Holzenthal, 1 male (in alcohol, NMNH); 1–4.v.1990, Holzenthal & Blahnik, 6 males, 1 female (in INBio: 5 males in alcohol; in UMSP: 1 male, 1 female); 6–10.iii.1991, Holzenthal, Muñoz & Huisman, 3 males (in alcohol, UMSP); **Puntarenas:** ~4.5 km E. of Golfito, [8° 39' N, 83° 9' W, el. 278 m], 3–4.vii.1967, Flint & Ortiz, 3 males (NMNH); Río Jaba and rock quarry 1.4 km (air) W. Las Cruces [San Vito de Jaba], 8.79° N, 82.97° W, el. 1150 m, 15.iii.1990, Holzenthal, Muñoz & Huisman, 1 male (UMSP). **PANAMA: Chiriqui:** Fortuna Dam Site, near Hornitos, 8° 44' N, 82° 16' W, el. 1050 m, 30.xi–13.xii.1977, H. Wolda, 1 male (in alcohol, NMNH); same except, 17.v.–25.vii.1978, H. Wolda, 1 male (in alcohol, NMNH).

**Etymology:** This new species is named in honor of Dr. Trond Andersen of the Museum of Zoology at University of Bergen (Norway) and his wife Maria and daughter Maria, as a gesture of gratitude for their appreciable and kind friendship, encouragement, and collaboration, and in recognition of his many contributions to systematics of Chironomidae and Trichoptera.

**Distribution:** COSTA RICA: Alajuela, Puntarenas; PANAMA: Chiriqui.

### ***Wormaldia tupacamara* Muñoz-Quesada & Holzenthal, new species**

Figures 97–103.

**Diagnosis.** This new species can be recognized from other known species of *Wormaldia* by the following 2 features in combination: 1) tergum VIII with a slight, posteromesal projection, which is covering a short, lightly sclerotized, subovate, subdorsal pouch (Fig. 98); and 2) tergum X with a relatively simple structure, having no process “a”, process “b” developed into a very weak bulge with a tiny spine, and with the “head” nearly semicircular, with its apices very weakly developed (Fig. 97).

**Description.** Adult: Length of male forewing 4.5 mm. Color in alcohol: Head light brown, with yellowish setae. Antenna long, slender, yellowish, with small, yellowish setae. Maxillary palps light brown, with yellowish setae. Labial palps yellowish, with lighter setae. Dorsum of thorax yellowish. Legs yellowish, with small, yellowish setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (Fig. 235); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (Fig. 103).

**Male genitalia** (Figs. 97–101): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII with slight, posteromesal projection covering small, light, subovate, subdorsal pouch; when viewed laterally, posterodorsal corner with tiny apex of posterior projection. Sternum VIII with small, convex, posteromesal projection, less than 0.2 times length of sternum VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly subrectangular in appearance, convexly projected anterad, nearly concave posteriorly; when viewed ventrally, concave anteriorly, weakly sinuous posteriorly with very shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” sublateral, weakly developed into very weak bulge with light, tiny spine; “head” nearly semicircular, with anterior

apex tiny, semicircular, lateral apices weakly roundly projected, posterior apex widely rounded; when viewed laterally, slender, slightly concavely curved preapicodorsally, “head” subovally elongate. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, rounded apically; when viewed laterally, subovally elongate at midlength, slightly shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength; apical segment slender, tubularly elongate, nearly equal in length, narrower than basal segment, slightly concave at midlength, widest and rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 3/4ths, separated posteromesally by shallow, wide, U-shaped emargination, each basal segment stout, weakly widest at midlength, with outer margin slightly convexly curved, apical segment tubularly elongate, widest and rounded posteriorly, with elongate, apicolateral patch of short, thin, black, spine-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with single visible, internal sclerite (Fig. 101).

**Holotype:** Male. **BOLIVIA: La Paz:** Yungas, Puente Mururata to Cusilloni, [16° 8' S, 67° 44' W], el. 1600m, 26–28.xi.1984, L. E. Peña G. (alcohol, NMNH).

**Etymology:** This new species is named in honor of Túpac Amaru (José Gabriel Condorcanqui, 1740–1781, Peru) who led the Incas during many years of rebellion against the Spanish occupation in Latin America.

**Distribution:** BOLIVIA: La Paz.

### ***Wormaldia zunigae* Muñoz-Quesada & Holzenthal, new species**

Figures 182–186.

**Diagnosis.** This new species is closely related to *W. bolivari* and *W. savoriorum*. These 3 species are distinguished from other species of *Wormaldia* by the following diagnostic characters in combination: 1) tergum VIII with a posteromesal, shelf with its posterior margin smoothly concave (Figs. 168, 178, 183); and 2) apical segment of the inferior appendage noticeably shorter than the basal segment (Figs. 167, 177, 182). *Wormaldia zunigae* is distinguished from the other 2 species by the following combination of distinctive features: 1) tergum VIII with 2 conspicuous, knob-shaped, posteromesal projections, separating a wide, deep, U-shaped emargination, which is clearly covered basomedially by a smooth, concave shelf (Fig. 183); 2) tergum X with process “a” lambda-shaped and strongly elongate, process “b” small, obtusely triangular, and located past midlength, and the “head” subtriangularly flattened, with the anterior apex stout, conspicuously elongate, and with lateral extensions (Fig. 183); and 3) when viewed laterally, the apical segment of the inferior appendage is rectangularly elongate, slightly concave in its middle, and roundly widened posteriorly (Fig. 182).

**Description.** Adult: Length of male forewing 5.5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 165); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 166).

**Male genitalia** (Figs. 182–186): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII slightly projected posterad, having 2 conspicuous, convexly knob-shaped, posteromesal projections separated by wide, deep, U-shaped emargination clearly covered basomedially by smooth, concave shelf; when viewed laterally, posterior margin slightly concave, dorsally with rounded apex of posterior projection. Sternum VIII with broad, convex, posteromesal projection, about 0.2 times sternum VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, nearly rectangular in appearance, convex anteriorly, slightly concave posteriorly; when viewed ventrally, weakly concave anteriorly, weakly sinuous posteriorly with shallow, mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” anteromedial mesally, conspicuous, lambda-shaped, strongly elongate, reaching middle of tergum; process “b” lateral in upper middle, small, obtusely triangular, projected laterad; “head” subtriangularly flattened, with anterior apex stout, conspicuously elongate, with lateral extensions, lateral apices small, convexly projected, posterior apex wide, rounded; when viewed laterally, stout, convexly extended mid-dorsally, concavely curved preapicodorsally, “head” wide, semicircular with apex lateral. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout, subovate



posteriorly; when viewed laterally, subovally elongate at midlength, shorter than segment X. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment stout, rectangular, tubularly elongate, shorter (about 0.9 times) and narrower than basal segment, very weakly concave and narrowest at midlength, roundly widened posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/3rds, separated posteromesally by moderately deep, U-shaped emargination, each basal segment stout, widest at midlength, with outer margin convexly curved, apical segment stout, subrectangularly elongate, subovally widened posteriorly, with elongate, apical patch of short, thin, black, spine-shaped setae. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 186).

**Holotype:** Male. **COLOMBIA: Risaralda:** Termales de Santa Rosa de Cabal, [4° 52' N, 75° 38' W], 29.ii.1984, C. M. & O. S. Flint, Jr. (NMNH).

**Etymology:** This new species is named in honor of Dr. María del Carmen Zúñiga de Cardoso of the Universidad del Valle, Cali, Colombia and her family, as a gesture of gratitude for their appreciable and kind friendship, encouragement, and collaboration, and in recognition of her contributions to the study and conservation of Colombian aquatic ecosystems.

**Distribution:** COLOMBIA: Risaralda.

### ***Wormaldia zunigarceorum* Muñoz-Quesada & Holzenthal, new species**

Figures 143–147.

**Diagnosis.** Among the known species of *Wormaldia*, this new species is clearly distinguished by the shape of tergum VIII. The posterior margin of tergum VIII has 2 narrow and extremely elongate, midlateral processes, which are about 0.3 times the length of tergum VIII (Fig. 144). Additionally, the apical segment of the inferior appendage is rectangular, narrow, very tubularly elongate, and rounded posteriorly (Fig. 143).

**Description.** Adult: Length of male forewing 4–5 mm. Head brown, with yellowish setae. Antenna long, slender, yellowish, with small, brown and yellowish rings of small setae. Maxillary palps yellowish, with brown setae. Labial palps yellowish, with brown setae. Dorsum of thorax yellowish. Legs yellowish, with small, brown setae. Forewing yellowish, covered with fine, small, brown setae, with apical forks I, II, III, IV, and V present (as in Fig. 197); hind wing translucent, with few fine, small, brown setae, with apical forks I, II, III, and V present (as in Fig. 198).

**Male genitalia** (Figs. 143–147): Sternum VII straight posteriorly without mesal projection or process. Tergum VIII having 2 conspicuous, narrow, posteromesal processes prominently acutely elongate (about 0.3 times length of tergum VIII), flanking section with many tiny spines; when viewed laterally, posterior margin sinuous, dorsally with acute, posterior half of apex of posterior process. Sternum VIII with convex and posteromesal projection, about 0.2 times sternum VIII. Segment IX, when viewed dorsally, concave anteriorly; when viewed laterally, broad, nearly C-shaped in appearance, convexly projected anterad, concave posteriorly; when viewed ventrally, concave anteriorly, sinuous posteriorly with mesal concavity. Segment X, when viewed dorsally, subtriangularly elongate, with process “a” absent; process “b” sublateral, nearly semiovate, elongate, projected laterad; “head” subtriangular, flattened, with anterior apex conspicuous, elongate subovally, lateral apices narrow, subtriangularly projected, posterior apex tiny, convex; when viewed laterally, stout, convexly extended mid-dorsally, concavely curved preapicodorsally, “head” wide, semicircular, with lateral apex. Superior appendage digitate; when viewed dorsally, parallel with segment X, stout; when viewed laterally, slightly elongate, shorter than segment X, slightly bulged at midlength. Inferior appendage 2-segmented; when viewed laterally, basal segment stout, subrectangular, elongate, broadest and convex at midlength, apical segment slender, rectangularly narrow, clearly tubularly elongate, longer (about 1.2 times) and narrower than basal segment, rounded posteriorly; when viewed dorsally, apical segment as in ventral view; when viewed ventrally, basal segments fused, united for about their anterior 2/5ths, separated posteromesally by narrow, very deep, V-shaped emargination, each basal segment thick, widest at midlength, with outer margin convexly curved, apical segment subtriangularly elongate, narrowest posteriorly, with strongly elongate patch of short, black, spine-shaped and peg-shaped setae on inner margin. Phallus, when viewed laterally, pistol-shaped, widest basally, tapering from middle to apex, membranous apically, very lightly sclerotized, with 2 visible, internal sclerites (Fig. 147).

**Holotype:** Male. **COSTA RICA: Cartago:** 5 km W. of Turrialba, [9° 54' N, 83° 40' W, el. 638 m], 18.–21.vi.1967, Flint & Ortiz (NMNH).

**Paratypes:** **COSTA RICA: Alajuela:** Parque Nacional Rincón de la Vieja, Quebrada Provisión, 10.769° N, 85.281° W, el. 810 m, 4.iii.1986, Holzenthal & Fasth, 1 male (in alcohol, UMSP); **Cartago:** 5 km W. of Turrialba, [9° 54' N, 83° 40' W, el. 638 m], 18.–21.vi.1967, Flint & Ortiz, 1 male, 1 female (in NMNH); **Guanacaste:** Parque Nacional Guanacaste, Estación Pitilla, Río Orosí. 10.991° N, 85.428° W, el. 700 m, 19–20.vii.1988, C. M. & O. S. Flint, Jr. & Holzenthal, 2 males (1 male in INBio; 1 male in UMSP); same except, iii.1994, Fdo. J. Muñoz-Q., 16 males (in INBio: 8 males in alcohol; in NMNH: 4 males in alcohol; in UMSP: 4 males in alcohol); **Limón:** Río San Rafael, near La Rita (Guápiles), 10° 13' N, 83° 46' W, el. 270 m, 11.x.1993, Fdo. J. Muñoz-Q., 2 males (in alcohol, UMSP); **Puntarenas:** Península de Osa, Rancho Quemado, 29.x.–23.xi.1993, H. Marín & H. Gutiérrez, 1 male, 1 female (in alcohol, UMSP). **PANAMA: Panama:** Barro Colorado Island, [9° 8' 59" N, 79° 50' 59" W], Snyder-Molino Trail, 10–16.vi.1987, H. Wolda, 1 male (in alcohol, NMNH); same except, Snyder-Molino Trail, 2–8.xii.1987, H. Wolda, 1 male (in alcohol, UMSP); Snyder-Molino Trail, 10–16.viii.1988, H. Wolda, 1 male (in alcohol, INBio); Snyder-Molino Trail, 2–8.viii.1989, H. Wolda, 1 male (in alcohol, NMNH); Snyder-Molino Trail, 22–28.xi.1989, H. Wolda, 1 male (in alcohol, NMNH); Snyder-Molino Trail, 9–15.v.1990, H. Wolda, 1 male (in alcohol, NMNH); Snyder-Molino Trail, 23–29.v.1990, H. Wolda, 2 males (in alcohol, NMNH); Snyder-Molino Trail, 26.ix.–20.x.1990, H. Wolda, 2 males (in alcohol, NMNH); Snyder-Molino Trail, 17–23.x.1990, H. Wolda, 2 males (in alcohol, NMNH); Snyder-Molino Trail, 16–22.i.1991, H. Wolda, 1 male (in alcohol, NMNH).

**Etymology:** This new species is named in honor of the family Zuñiga Arce, as a gesture of gratitude for their appreciable and kind family spirit, encouragement, and cooperation.

**Distribution:** COSTA RICA: Alajuela, Cartago, Guanacaste, Limón, Puntarenas; PANAMA: Panama.

## Key of males of Neotropical *Wormaldia*

Some morphological characters used diagnostically for separating and identifying species displayed some variation in shape from that of the holotype. Consequently, it may be necessary to use a combination of several diagnostic morphological characters of the male genitalia to verify a determination. We recommend that users of this key corroborate their species determinations with the accompanying diagnoses, descriptions, illustrations, and distributional data. It is also important that users of this key read the morphological considerations in the section on materials and methods before using this key.

*Wormaldia alicia* was not examined in this study and is not included in the key. See diagnosis and explanation on page 50. The smooth shelf covering the U-shaped emargination of tergum VIII is usually conspicuous, but in 3 species (*W. barbai*, *W. bolivari*, *W. hedamafera*), it may be less conspicuous. Accordingly, at couplet 29 either choice will lead to the identification of these species as each appears twice in the key depending on whether the emargination appears to be covered by a smooth shelf (lead 29) or not (lead 29').

Finally, genitalic illustrations for this genus of a hypothetical male, with the accompanying terminology used in this taxonomic monograph for the component structures, are presented in Figs. 1–6. This identification key only uses morphological characters of the male genitalia. For a key to the Nearctic species, including *W. arizonensis* and *W. plana* (also keyed below) the user is referred to the work by Muñoz-Quesada & Holzenthal (2008).

1. Tergum IX, when viewed laterally, with anterior margin bearing hook-shaped projection anterodorsally (Figs. 7, 11, 18, 23, 28, 33) ..... 2
- 1'. Tergum IX without hook-shaped projection ..... 7
- 2 (1). Tergum VIII with conspicuous, wide, concave, posteromesal emargination (Figs. 8, 12, 19, 24) ..... 3
- 2'. Tergum VIII with posterior margin projected posteromesad (Figs. 162, 167) ..... 6
- 3 (2). Tergum VIII, mesally, with semioval, subdorsal pouch conspicuously long, surpassing middle of tergum (Figs. 7–10) ..... *W. isela*, new species
- 3'. Tergum VIII, mesally, without subdorsal pouch, or with small, subdorsal pouch, about 0.2 times length of tergum (Figs. 12, 24) ..... 4
- 4 (3'). Segment IX, when viewed laterally, with anterior margin slightly, convexly projected (Figs. 18, 23); tergum X with process “b” weakly developed, when viewed laterally, with the “head” having dorsal margin upcurved preapically ..... 5
- 4'. Segment IX, when viewed laterally, with anterior margin having conspicuously elongate, wide, convex projection (Fig. 11); tergum X, simple, triangular, without processes “a” and “b”, the “head” without anterior and lateral apices, when viewed laterally, tubularly elongate, straight (Figs. 11–17) ..... *W. dorsata* Ross & King

5 (4).	Tergum VIII with conspicuously wide, posteromesal emargination, without subdorsal pouch (Fig. 19); tergum X with process “b” developed into bulged projection with tiny spines; inferior appendage, when viewed laterally, with apical segment wide, rectangular, truncate posteriorly (Figs. 18–22).	.....	<i>W. fredycarol</i> , new species
5’.	Tergum VIII with narrow, posteromesal emargination surrounded by slender, subdorsal pouch (Fig. 24); tergum X with process “b” developed into narrow and elongate band; inferior appendage, when viewed laterally, with apical segment narrow, tubularly elongate, rounded posteriorly (Figs. 23–27).	.....	<i>W. luma</i> Bueno-Soria & Holzenthal
6 (2’).	Tergum VIII bearing semioval and subdorsal pouch (Fig. 29); segment IX, when viewed laterally, with anterior margin having conspicuously elongate, convexly widened projection; tergum X without process “b”, when viewed laterally, the “head” narrow, straight, tubularly elongate (Figs. 28–32).	.....	<i>W. maesi</i> , new species
6’.	Tergum VIII having an obtusely subtriangular subdorsal pouch (Fig. 34); segment IX, when viewed laterally, with anterior margin weakly, convexly projected; tergum X with process “b” developed into conspicuous spine, when viewed laterally, the entire tergum sinuously tubular, the “head” roundly widened (Figs. 33–37).	.....	<i>W. palma</i> Flint
7 (1).	Tergum VIII with posteromesal margin straight or very slightly concave, without processes, not conspicuously emarginate (Figs. 39, 43); tergum X simple, triangular, processes “a” and “b” absent (Figs. 39, 43).	.....	8
7’.	Tergum VIII with posteromesal margin emarginate (Figs. 161, 168) or slightly projected posterad, sometimes sinuously (Figs. 50, 55, 62, 98, 132), or having one or more processes (Figs. 136–137); tergum X complex, subtriangular, with at least processes “a” or “b” present.	.....	9
8 (7).	Tergum X, when viewed laterally, with the “head” noticeably hook-shaped, strongly upcurved, directed anteriorly (Figs. 38–41).	.....	<i>W. dampfi</i> Ross & King
8’.	Tergum X, when viewed laterally, with the “head” straight, directed posteriorly (Figs. 42–48).	.....	<i>W. endonima</i> Ross & King
9 (7’).	Inferior appendage, when viewed laterally, with apical segment having an ovate patch of setae subapicomeresally in inner margin not reaching posteroapical margin (Figs. 49, 54).	.....	10
9’.	Inferior appendage, when viewed laterally, with apical segment bearing patch of setae with different appearance than above reaching posteroapical margin.	.....	11
10 (9).	Tergum X with process “b” developed into tiny and pointed projection; inferior appendage, when viewed ventrally, with apical segment stout, rectangularly elongate, truncately widened posteriorly (Figs. 49–53).	.....	<i>W. chrismark</i> , new species
10’.	Tergum X with process “b” developed into narrow and ovate band; inferior appendage, when viewed ventrally, with apical segment narrow, tubularly elongate, rounded apically (Figs. 54–60).	.....	<i>W. flinti</i> , new species
11 (9’).	Tergum VIII with 3 small, subdorsal processes posteromesally (Figs. 61–67).	.....	<i>W. esperonis</i> Ross & King
11’.	Tergum VIII without subdorsal processes posteromesally	.....	12
12 (11’).	Tergum X with process “a” prominent, omega- or horseshoe “head” with anterior apex bifurcate, branches directed anterolaterally (Figs. 68–74).	.....	<i>W. araujoii</i> , new species
12’.	Tergum X with process “a” either absent, or not omega- or horseshoe-shaped, “head” with anterior apex either absent or not bifurcate.	.....	13
13 (12’).	Segment IX, when viewed laterally, with posterior margin having conspicuous and pointed projection dorsally (Figs. 75, 80, 85, 90).	.....	14
13’.	Segment IX, when viewed laterally, with posterior margin without pointed dorsal projection	.....	17
14 (13).	Tergum VIII with one or more posteromesal processes	.....	15
14’.	Tergum VIII with conspicuous, narrow, U-shaped, posteromesal emargination (Figs. 75–79).	.....	<i>W. dachiardiorum</i> , new species
15 (14).	Tergum VIII with one conspicuous posteromesal process	.....	16
15’.	Tergum VIII with 2 conspicuous bullhorn-shaped posteromesal processes (Figs. 80–84).	.....	<i>W. aymara</i> , new species
16 (15).	Tergum VIII with posteromesal process widely rectangular; inferior appendage, when viewed laterally, with apical segment broad, truncate posteriorly (Figs. 85–89).	.....	<i>W. inca</i> , new species
16’.	Tergum VIII with posteromesal process digitately elongate; inferior appendage, when viewed laterally, with apical segment narrow, tubularly elongate, rounded posteriorly (Figs. 90–96).	.....	<i>W. insignis</i> (Martynov)
17 (13’).	Tergum VIII with posterior margin slightly projected mesad, bearing small subdorsal pouch mesally (Figs. 97–103).	.....	<i>W. tupacamara</i> , new species
17’.	Tergum VIII with posterior margin conspicuously emarginate, or with one or more conspicuous stout processes.	.....	18
18 (17’).	Segment IX, when viewed laterally, with anterior margin very strongly and acutely projected (Figs. 104, 109, 114, 121), or forming prominent, acutely elongate projection (Figs. 126, 131, 136) [exceptions are <i>W. trondi</i> (Fig. 211), <i>W. tarasca</i> (Fig. 216), and <i>W. paprockevi</i> (Fig. 267), with distinctly produced, but convexly rounded projections]	.....	19
18’.	Segment IX, when viewed laterally, with anterior margin straight or less convexly developed	.....	25
19 (18).	Tergum X, when viewed dorsally, with the “head” noticeably triangular, anterior apex conspicuously triangular (Figs. 105, 110, 115), when viewed laterally, entire tergum X stout, with dorsal margin convex in middle, the “head” conspicuously triangularly elongate (Figs. 104, 109, 114).	.....	20
19’.	Tergum X, when viewed dorsally, with the “head” small, usually narrowly rounded, or subtriangular, with anterior apex conspicuously small and rounded (Figs. 122, 127, 132, 137), when viewed laterally, segment X narrow, tubularly elongate and stick-shaped posteriorly, the “head” tiny, tubular or slightly hook-shaped (Figs. 121, 126, 131, 136).	.....	22
20 (19).	Tergum VIII with posteromesal shelf distinctly covering the emargination basomedially; tergum X with process “a” lambda-shaped (Figs. 110, 115).	.....	21
20’.	Tergum VIII with posteromesal shelf only slightly covering the emargination basally; tergum X with process “a” an elongate, narrow, inverted U-shape, (Figs. 104–108).	.....	<i>W. gallardoi</i> , new species
21 (20).	Tergum X with process “a” strongly elongate, surpassing middle of tergum; inferior appendage, when viewed ventrally, with		

	apical segment slightly twisted posteroventrally (Figs. 109–113) . . . . .	<i>W. andrea</i> , new species
21'	Tergum X with process "a" only slightly elongate, barely reaching middle of tergum; inferior appendage, when viewed ventrally, with apical segment straight posteroventrally (Figs. 114–120) . . . . .	<i>W. proluxa</i> Flint
22 (19')	Tergum VIII with posterior margin having conspicuous, deep, U-shaped, mesal emargination (Figs. 122, 127) . . . . .	23
22'	Tergum VIII with posteromesal margin straight or slightly projected and weakly sinuous (Figs. 132, 137) . . . . .	24
23 (22)	Tergum X having process "a" semicircular; inferior appendage, when viewed laterally, with apical segment thumb-shaped, downcurved, longer than basal segment (about 1.1 times) (Figs. 121–125) . . . . .	<i>W. francovilla</i> , new species
23'	Tergum X having process "a" lambda-shaped; inferior appendage, when viewed laterally, with apical segment thumb-shaped, upcurved, about equal in length to basal segment (Figs. 126–130) . . . . .	<i>W. imberti</i> , new species
24 (22')	Tergum VIII without posteromesal processes; tergum X with process "a" prominent and semicircular (Figs. 131–135) . . . . .	<i>W. contrerasi</i> , new species
24'	Tergum VIII with 2 conspicuous and narrowly elongate posteromesal processes; tergum X with process "a" weakly developed and nearly subrectangular (Figs. 136–142) . . . . .	<i>W. machadorum</i> , new species
25 (18')	Tergum VIII with 2 slender and extremely elongate posteromesal processes, about 0.4 times length of tergum (Fig. 144); inferior appendage, when viewed laterally, with apical segment noticeably elongate tubular, markedly longer (about 1.2 times) and narrower than basal segment (Figs. 143–147) . . . . .	<i>W. zunigarceorum</i> , new species
25'	Tergum VIII with one or more shorter posteromesal processes, or posteromesal processes absent; inferior appendage, when viewed laterally, with apical segment subrectangularly elongate, subequal to or shorter than basal segment . . . . .	26
26 (25')	Tergum VIII without posterior emargination (Figs. 268, 275, 282) . . . . .	50
26'	Tergum VIII with conspicuous, U-shaped, posterior emargination . . . . .	27
27 (26')	Inferior appendage, when viewed laterally, with apical segment subquadrate, noticeably truncate, widened posteriorly, its apex as wide as or broader than basal segment (Figs. 148, 155) . . . . .	28
27'	Inferior appendage, when viewed laterally, with apical segment subtriangularly or subrectangularly elongate, rounded or subtruncate posteriorly, its apex narrower than basal segment . . . . .	29
28 (27)	Tergum VIII with posteromesal emargination not flanked by processes and covered basomedially by spiny shelf; tergum X with process "b" developed into slightly projecting, ovate bulge, the "head" with balloon appearance (Figs. 148–154) . . . . .	<i>W. boteroi</i> , new species
28'	Tergum VIII with 2 conspicuous posteromesal processes flanking U-shaped emargination that is not covered basomedially by spiny shelf; tergum X with process "b" triangular, the "head" with subtriangular appearance (Figs. 155–159) . . . . .	<i>W. eberhardi</i> , new species
29 (27')	Tergum VIII with conspicuous, U-shaped, posterior emargination covered by smooth (Figs. 161, 178) concavely projected (Fig. 193), spiny (Fig. 188), digitate (Fig. 200), or horn-like shelf (Fig. 207) . . . . .	30
29'	Tergum VIII with conspicuous, U-shaped, posterior emargination not covered by shelf (Figs. 234, 261, 217, 222) . . . . .	39
30 (29)	Tergum VIII with posteromesal shelf having posterior margin smooth (Figs. 168, 173) . . . . .	31
30'	Tergum VIII with posteromesal shelf having posterior margin spiny (Fig. 188) concavely produced (Fig. 193), or developed into digitate or horn-like processes (Figs. 200, 207) . . . . .	35
31 (30)	Tergum X with process "a" lambda or Y-shaped and process "b" triangular; inferior appendage, when viewed laterally, with apical segment narrower than basal segment . . . . .	32
31'	Tergum X with process "a" absent and process "b" developed into narrow, elongate band; inferior appendage, when viewed laterally, with apical segment strongly ovally widened posteriorly, apex nearly equal in width to basal segment (Figs. 160–166) . . . . .	<i>W. hedamafera</i> , new species
32 (31)	Tergum VIII with deep, U-shaped, posteromesal emargination; tergum X with process "a" lambda- or Y-shaped, elongate, at least reaching middle of tergum; inferior appendage, when viewed laterally, with apical segment tubularly elongate, rounded posteriorly . . . . .	33
32'	Tergum VIII with shallow posteromesal emargination; tergum X with process "a" lambda-shaped, small, not reaching middle of tergum; inferior appendage, when viewed laterally, with apical segment subrectangular, truncated posteriorly (Figs. 167–171) . . . . .	<i>W. bolivari</i> , new species
33 (32)	Tergum VIII with posteromesal shelf covering the emargination basomedially; tergum X with process "a" lambda-shaped, small, barely reaching middle of tergum; phallus with small and spiny sclerites . . . . .	34
33'	Tergum VIII with posteromesal shelf only slightly covering the emargination basally; tergum X with process "a" Y-shaped, strongly elongate, surpassing middle of tergum; phallus with 1 sclerite noticeably sinuous and prominently long, about 1.1 times the length of segment VIII (Figs. 172–176) . . . . .	<i>W. barbai</i> , new species
34 (33)	Tergum X, with process "b" triangularly elongate, the "head" narrowly and convexly subtriangular, its anterior apex small, semicircular, and without lateral extensions (Figs. 177–181) . . . . .	<i>W. savoriorum</i> , new species
34'	Tergum X, with process "b" triangular and small, the "head" flattened and subtriangular, its anterior apex triangularly elongate, and with lateral extensions (Figs. 182–186) . . . . .	<i>W. zunigae</i> , new species
35 (30')	Tergum VIII with posteromesal shelf having posterior margin weakly and concavely produced (Fig. 193), or developed into one or more conspicuous, digitate or horn-like processes (Figs. 207, 212); inferior appendage, when viewed laterally, with apical segment straight and rectangularly elongate . . . . .	36
35'	Tergum VIII with posteromesal shelf conspicuously serrated or spiny; inferior appendage, when viewed laterally, with apical segment thumb-shaped and downcurved (Figs. 187–191) . . . . .	<i>W. lauglo</i> , new species
36 (35)	Tergum VIII with posteromesal shelf having posterior margin produced conspicuously into one or more conspicuous, digitate or horn-like processes (Figs. 207, 212) . . . . .	37
36'	Tergum VIII with posteromesal shelf having posterior margin weakly and concavely produced (Figs. 192–198) . . . . .	



.....	<i>W. menchucae</i> , new species	
37 (36'). Tergum VIII with posteromesal shelf having posterior margin produced into 2 digitate or horn-like processes.....		38
37'. Tergum VIII with posteromesal shelf having posterior margin produced into one digitate process (Figs. 199–205) .....	<i>W. juarox</i> , new species	
38 (37). Tergum VIII with posteromesal processes slender and separated by wide, shallow, U-shaped emargination; tergum X with process “a” lambda-shaped, the “head” triangular, with lateral apices convexly triangular (Figs. 206–210) .....	<i>W. calderonae</i> , new species	
38'. Tergum VIII with posteromesal processes pointed and stout, separated by narrow, deep, U-shaped emargination; tergum X with process “a” cordate, the “head” semicircular (Figs. 211–215) .....	<i>W. trondi</i> , new species	
39 (29'). Tergum VIII with noticeably wide posteromesal emargination (Figs. 217, 222, 229); tergum X with process “a” lambda-shaped, strongly diverging basally, prominent and large, the “head” without apices, notably wide, balloon-shaped (Figs. 216, 217, 221, 222, 228, 229); inferior appendage, when viewed laterally, with apical segment triangular or subtriangular, clearly shorter than basal segment (Figs. 216, 221, 228) .....		40
39'. Tergum VIII with U-shaped posteromesal emargination (Figs. 234, 239, 256); tergum X with process “a” narrow, lambda, U, i????????, or Y-shaped, or absent, the “head” narrowly subtriangular, with anterior and lateral apices (Figs. 239, 261); inferior appendage, when viewed laterally, with apical segment subrectangularly elongate (Figs. 128, 255, 243). . . . .		42
40 (39). Tergum VIII with posterior margin lacking subdorsal shelf; superior appendage, when viewed laterally, with dorsal margin strongly and convexly produced (Figs. 221, 228) .....		41
40'. Tergum VIII with posterior margin bearing subdorsal shelf parallel to the emargination; superior appendage, when viewed laterally, digitate, relatively uniform in width, not convexly produced (Figs. 216–220) . . .	<i>W. tarasca</i> Bueno-Soria & Holzenthal	
41 (40). Tergum VIII with posteromesal projections flanking the mesal emargination; inferior appendage, when viewed laterally, with apical segment triangular, uniformly tapered to apex, rounded posteriorly (Figs. 221–227) .....	<i>W. arizonensis</i> (Ling)	
41'. Tergum VIII without posteromesal projections flanking the mesal emargination; inferior appendage, when viewed laterally, with apical segment subtriangular, noticeably narrowed and pointed posteriorly (Figs. 228–232) .....	<i>W. navarroae</i> , new species	
42 (39'). Tergum X with process “a” present, process “b” developed subtriangularly; inferior appendage, when viewed laterally, with apical margin rounded or truncated posteriorly, its apex narrower than basal segment (Fig. 172). . . . .		43
42'. Tergum X with process “a” absent, process “b” developed into narrow and elongate band; inferior appendage, when viewed laterally, with apical segment strongly ovally widened posteriorly, nearly equal in width to basal segment (Figs. 160–166) . . .	<i>W. hedamafera</i> , new species	
43 (42). Phallus with small and spine-shaped sclerites. . . . .		44
43'. Phallus with sclerite noticeably sinuous and prominently long, about 1.1 times length of segment VIII (Figs. 172–176) .....	<i>W. barbai</i> , new species	
44 (43). Tergum VIII with U-shaped posteromesal emargination not surrounded basomedially by mesodorsal invagination. . . . .		45
44'. Tergum VIII with deep, U-shaped, posteromesal emargination, noticeably narrowed in middle and surrounded basomedially by mesodorsal invagination (Figs. 233–237). . . . .	<i>W. monsonorum</i> , new species	
45 (44). Tergum VIII with deep posteromesal emargination; inferior appendage, when viewed laterally, with apical segment rounded or ovate posteriorly .....		46
45'. Tergum VIII with shallow posteromesal emargination; inferior appendage, when viewed laterally, with apical segment truncate posteriorly (Figs. 167–171). . . . .	<i>W. bolivari</i> , new species	
46 (45). Tergum VIII with posteromesal emargination flanked by well-developed horn-like (Fig. 239), triangular (Fig. 244), or knob-shaped (Fig. 249) processes .....		47
46'. Tergum VIII with posteromesal emargination no flanked by well-developed processes (Figs. 256, 261). . . . .		49
47 (46). Tergum VIII with 2 triangular (Fig. 244) or knob-shaped (Fig. 249) posteromesal processes; tergum X with process “a” Y-shaped, elongate, surpassing the middle of tergum; inferior appendage, when viewed laterally, with apical segment shorter than basal segment .....		48
47'. Tergum VIII with 2 stout, elongate, horn-shaped posteromesal processes; tergum X with process “a” U-shaped, narrowed posteriorly; inferior appendage, when viewed laterally, with apical segment nearly equal in length to basal segment (Figs. 238–242) .....	<i>W. cornuta</i> Bueno-Soria & Holzenthal	
48 (47). Tergum VIII with 2 acutely triangular posteromesal processes; inferior appendage, when viewed dorsally, with apical segment subrectangularly elongate, truncate apically, bearing an apical patch of setae (Figs. 243–247). . . . .	<i>W. buenorum</i> , new species	
48'. Tergum VIII with 2 knob-shaped posteromesal processes, inferior appendage, when viewed dorsally, with apical segment sub-ovally elongate posteriorly, bearing an ovate, apicolateral patch of setae (Figs. 248–254) .....	<i>W. planae</i> Ross & King	
49 (46'). Tergum X with process “a” lambda-shaped, elongate, reaching middle of tergum; inferior appendage, when viewed laterally, with apical segment thumb-shaped, ovally elongate posteriorly, having conspicuously rounded patch of setae posterodorsally (Figs. 255–259). . . . .	<i>W. anhelitus</i> , new species	
49'. Tergum X with process “a” small and inverted U-shaped; inferior appendage, when viewed laterally, with apical segment rectangular, noticeably narrow, tubularly elongate, bearing small patch of setae apicolaterally on inner margin (Figs. 260–266). . .	<i>W. tocajoma</i> , new species	
50 (26). Tergum VIII with one M-shaped posteromesal process; tergum X with process “a” absent, the “head” noticeably narrow and rounded (Figs. 267–273). . . . .	<i>W. paprockevi</i> , new species	
50'. Tergum VIII with 2 or more posteromesal processes; tergum X with process “a” present, the “head” subtriangular and with lateral apices .....		51
51 (50'). Tergum VIII with posterior margin having 2 small, knob-shaped, mesal processes flanking spiny section; tergum X with pro-		

- cess “a” nearly lambda-shaped, process “b” small and triangular at past midlength (Figs. 274–280). . . . . *W. gonzalezae*, new species
- 51’. Tergum VIII with posterior margin bearing 2 conspicuous, knob-shaped, mesal processes flanking subrectangular mesal process; tergum X with process “a” Y-shaped, process “b” strongly triangularly elongate (Figs. 281–287). . . . *W. matagalpa* Flint

## Acknowledgements

We are grateful to institutions, museums, universities, and their curators who promptly provided specimens. They are as follows: University of Minnesota Insect Collection, (UMSP, St. Paul, MN, USA, Dr. Phil Clausen), Instituto de Biología de la Universidad Nacional Autónoma de México (IBUNAM, Mexico City, Mexico, Dr. Joaquin Bueno-Soria and Mr. Rafael Barba), Illinois Natural History Survey (INHS, Champaign, IL, USA, Dr. Kathleen Reid Zeiders), Monte L. Bean Life Science Museum of the Brigham Young University (BYU, Provo, UT, USA, Dr. Richard W. Baumann), California Academy of Sciences (CAS, San Francisco, CA, USA, Dr. Norman D. Penny and Dr. Vincent L. Lee), Canadian National Collection (CNC, Ottawa, ON, Dr. P. T. Dang and Dr. J. Smith), Museum of Comparative Zoology (MCZ, Harvard University, Cambridge, MA, USA, Dr. P. D. Perkins), Oregon State Arthropod Collection of the Oregon State University (OSAC, Corvallis, OR, USA, Dr. Andrew D. Warren), National Museum of Natural History (NMNH, Washington, D.C., USA, Dr. Oliver S. Flint, Jr.). Dr. Flint also provided invaluable assistance throughout this study and accomodated our many questions and requests for specimens. We are especially grateful to Jolanda Huisman for her help in organizing and reviewing the manuscript and for her assistance in the field. Dr. Brian Armitage, Dr. Tanya Arefina-Armitage, and Dr. Roger Blahnik provided valuable reviews of the paper. We also thank Dr. John Morse for his valuable and detailed editorial suggestions. The senior author express his thanks to his PhD committee members, Drs. R. W. Holzenthal, William Miller (1930–2013), Marla Spivak, Susan Weller, and Elmer C. Birney (1940–2000), for their guidance and valuable suggestions during his academic years working on his dissertation project. Also, FJMQ extends sincerest gratitude to Dr. Ingrid González-Gibson of the Dumbarton Oaks Research Library, Washington, D.C., all faculty and administrative staff in the Department of Entomology of the University of Minnesota and Universidad de Antioquia (Medellín, Colombia), and the librarian staff of the Entomology, Fisheries, and Wildlife Library of the University of Minnesota for their valued help with many publications. Finally, FJMQ gratefully acknowledges Drs. Ricardo Callejas-Posada, Juth Jineth Berrio-Martínez, Yohana Agudelo-A., Denis Mairú Hincapié-Montoya, and José Andrés Posada-García of the Universidad de Antioquia (Univeridad de Antioquia, Colombia) for their support and collaboration. Dr. John C. Morse and two anonymous reviewers provided constructive comments that improved the manuscript greatly. This material is based upon work supported by the National Science Foundation under Grant Nos. DEB-9400632 and DEB-0117772. In addition, FJMQ was supported by a Doctoral Dissertation Fellowship, University of Minnesota Graduate School, the MacArthur Interdisciplinary Program on Peace and International Cooperation, University of Minnesota, the Dayton/Wilkie Natural History Funds, Bell Museum of Natural History, University of Minnesota, and the Marion Brooks-Wallace Award, Department of Entomology, University of Minnesota. This support is gratefully acknowledged.

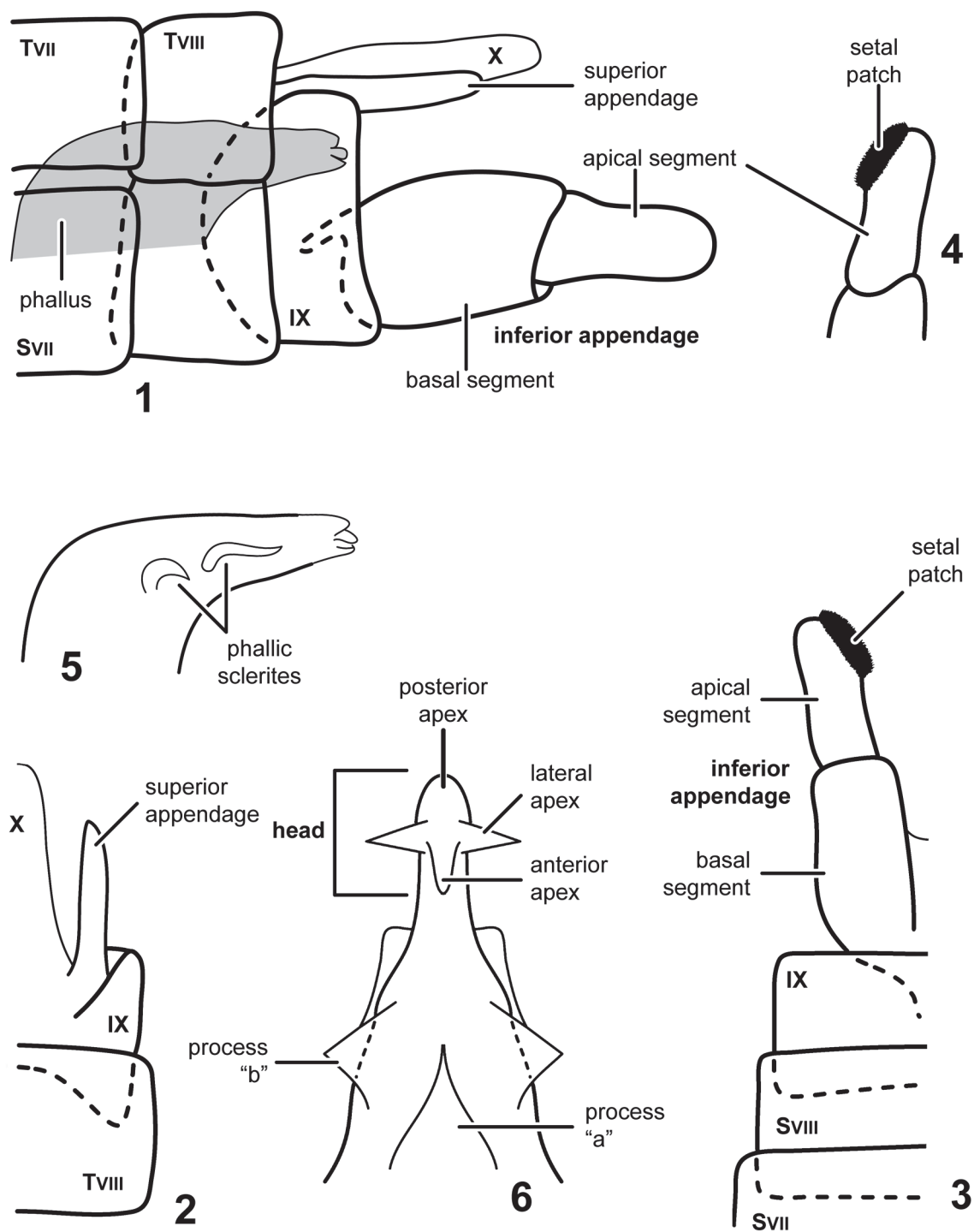
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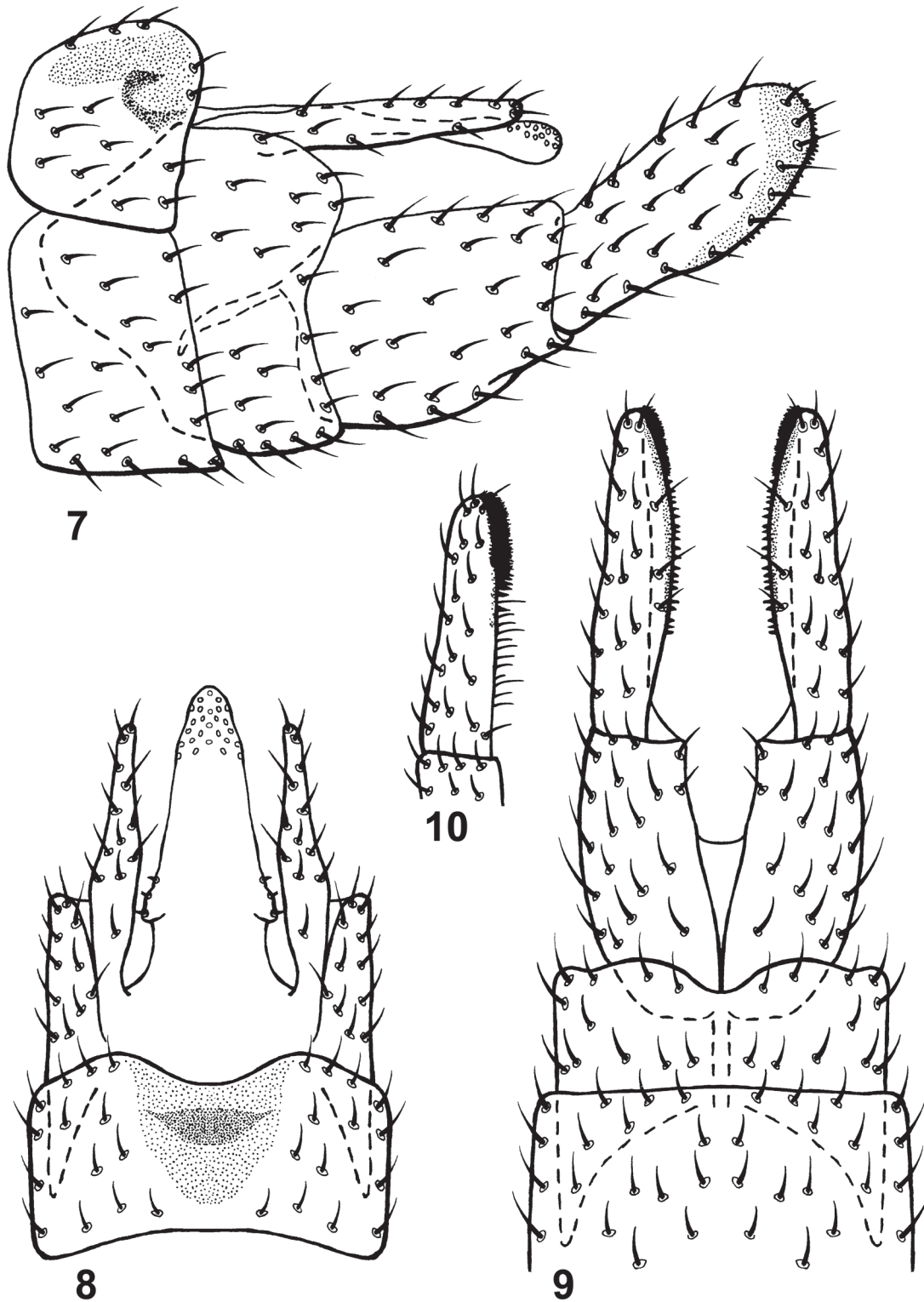
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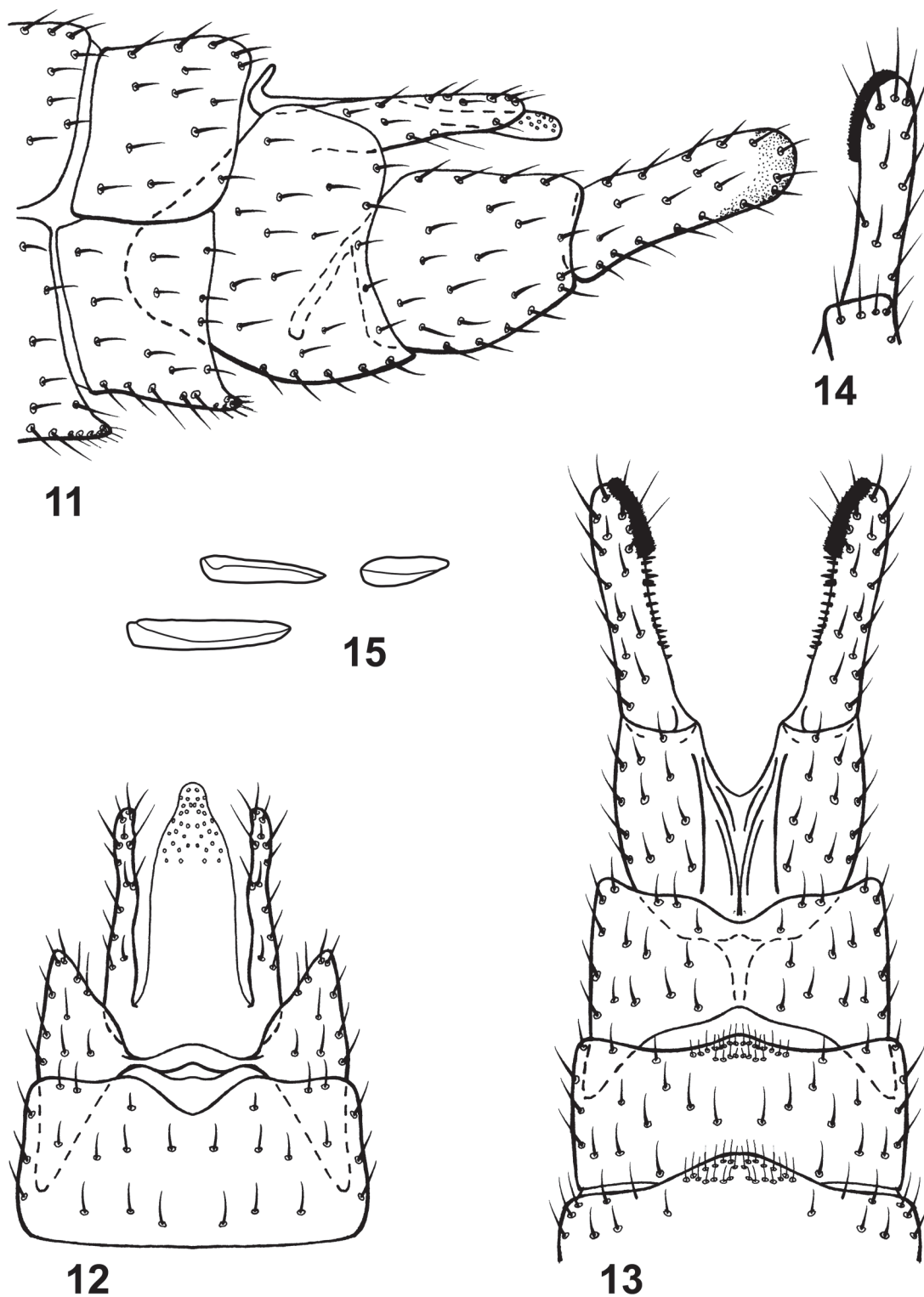




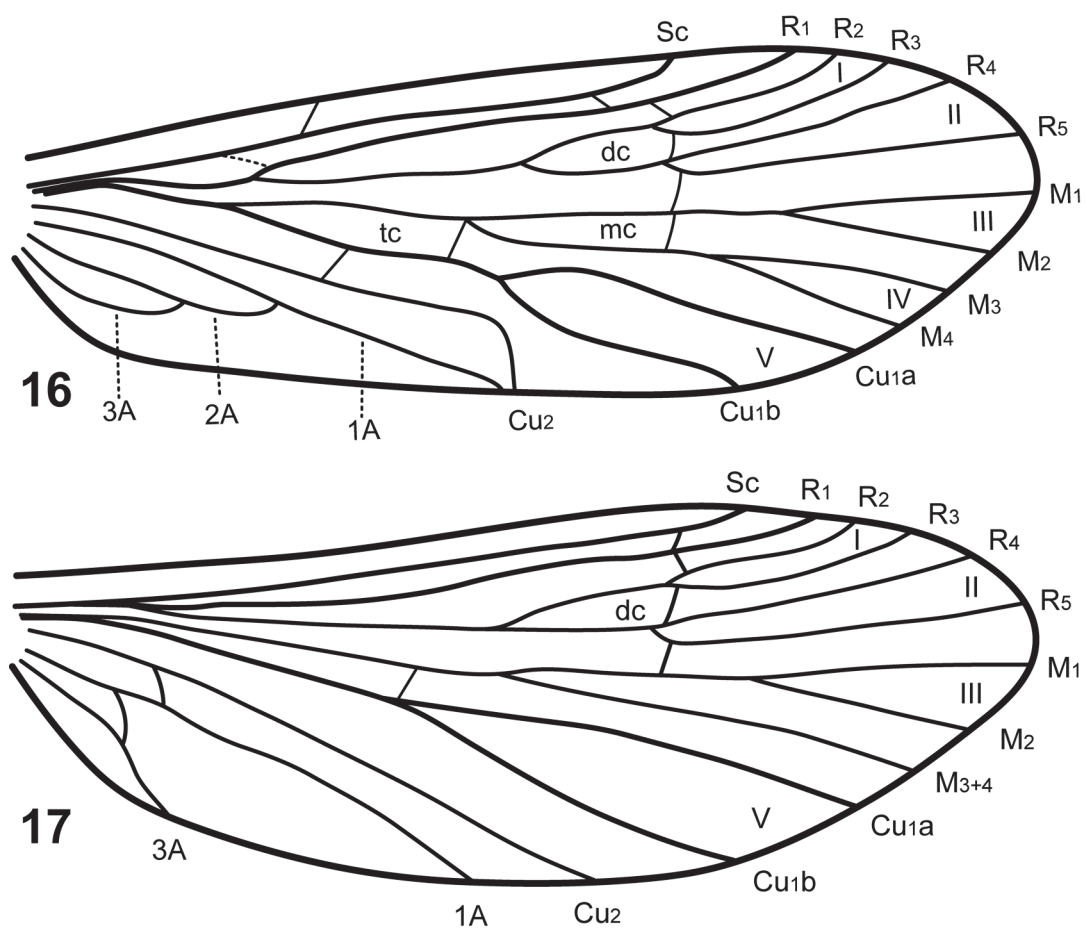
**FIGURES 1–6.** Hypothetical male genitalia of *Wormaldia*: 1, left lateral; 2, left side, dorsal; 3, left side, ventral; 4, apical segment of left inferior appendage, dorsal; 5, phallus with sclerites, left lateral; 6, segment X, dorsal.



**FIGURES 7–10.** *Wormaldia isela*, new species. Male genitalia: 7, left lateral; 8, dorsal; 9, ventral; 10, apical segment of right inferior appendage, dorsal.

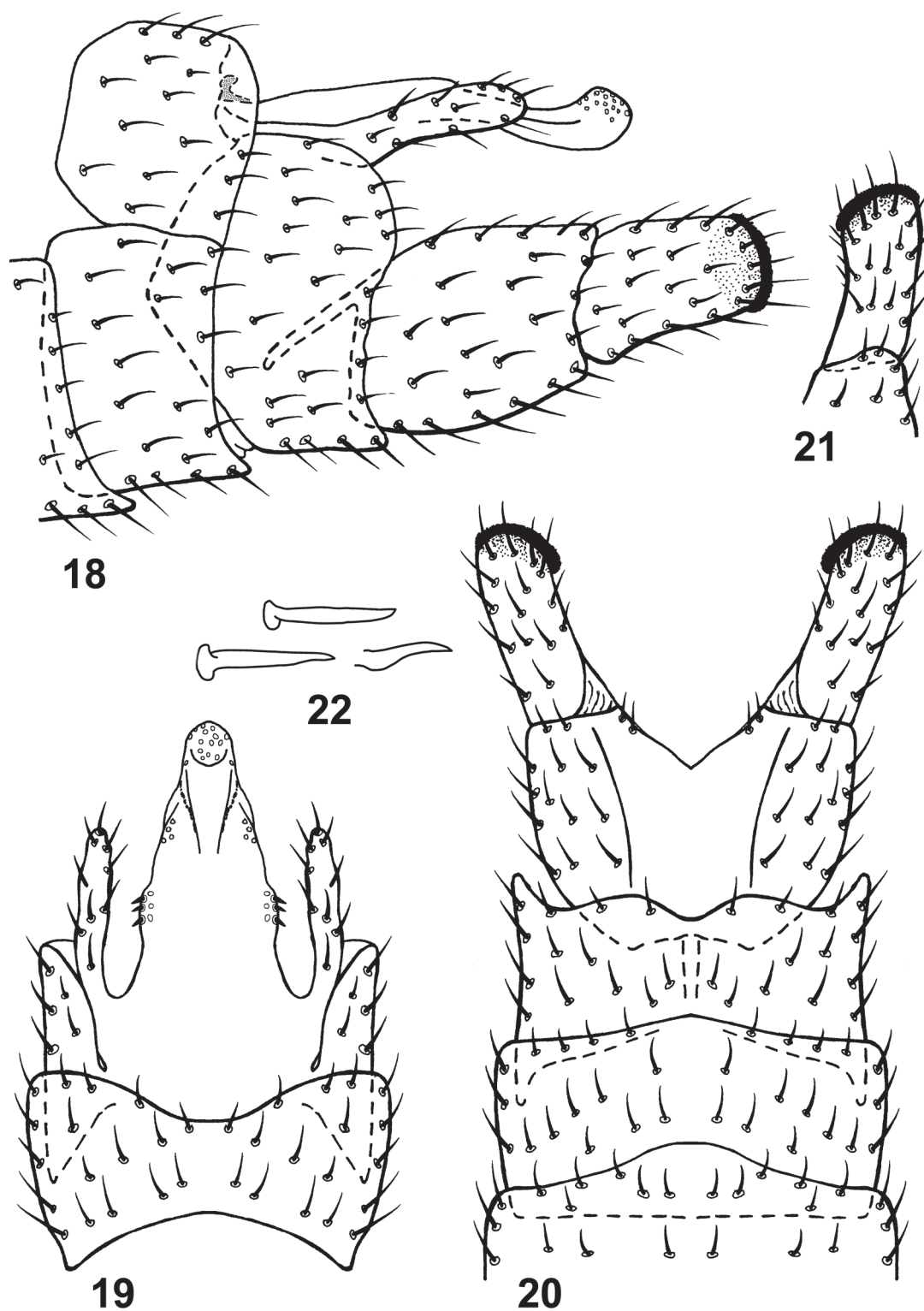


**FIGURES 11–15.** *Wormaldia dorsata* Ross & King. Male genitalia: 11, left lateral; 12, dorsal; 13, ventral; 14, apical segment of left inferior appendage, dorsal; 15, phallic sclerites.

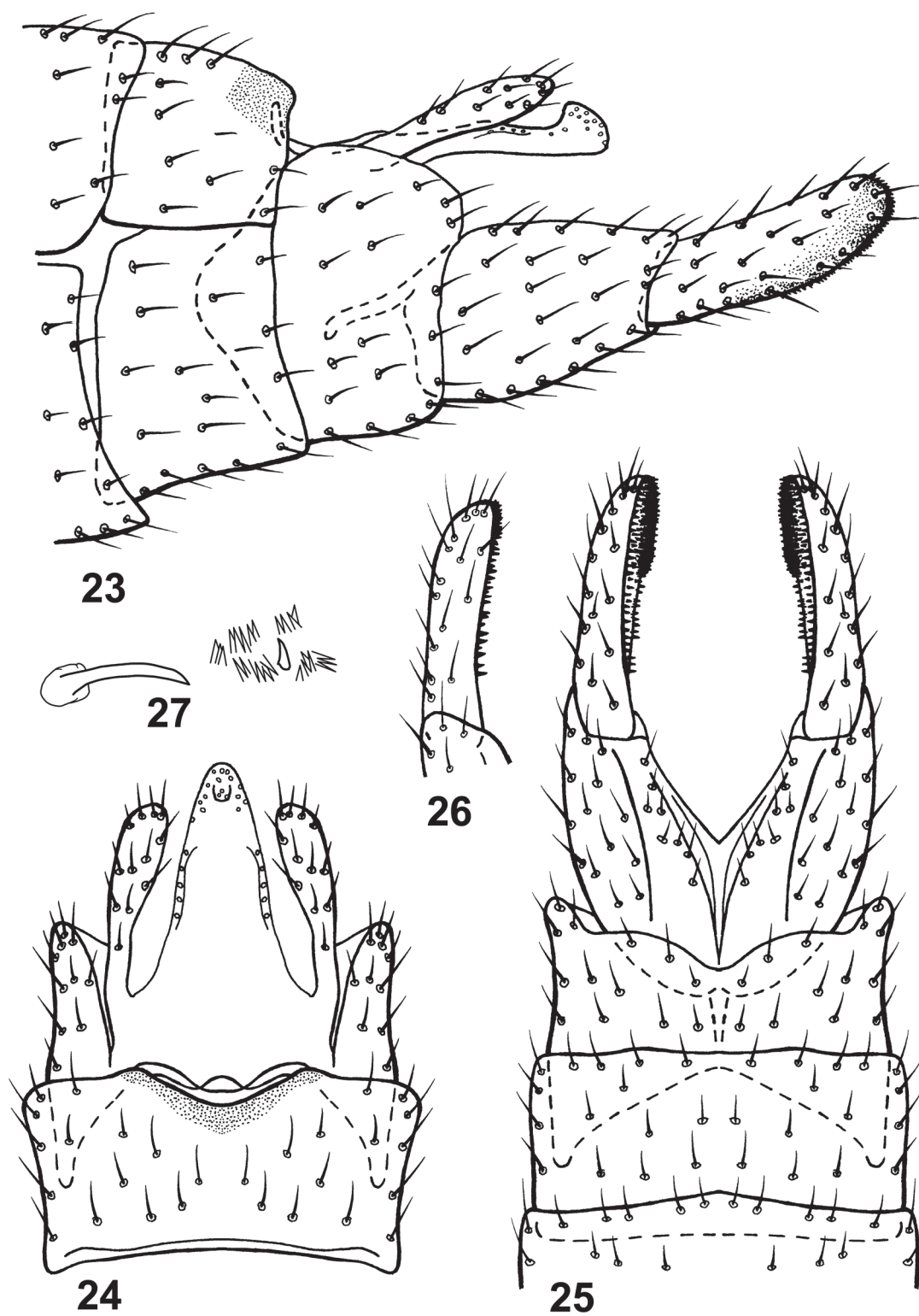


**FIGURES 16–17.** *Wormaldia dorsata* Ross & King. Wings: 16, right forewing, dorsal; 17, right hind wing, dorsal.

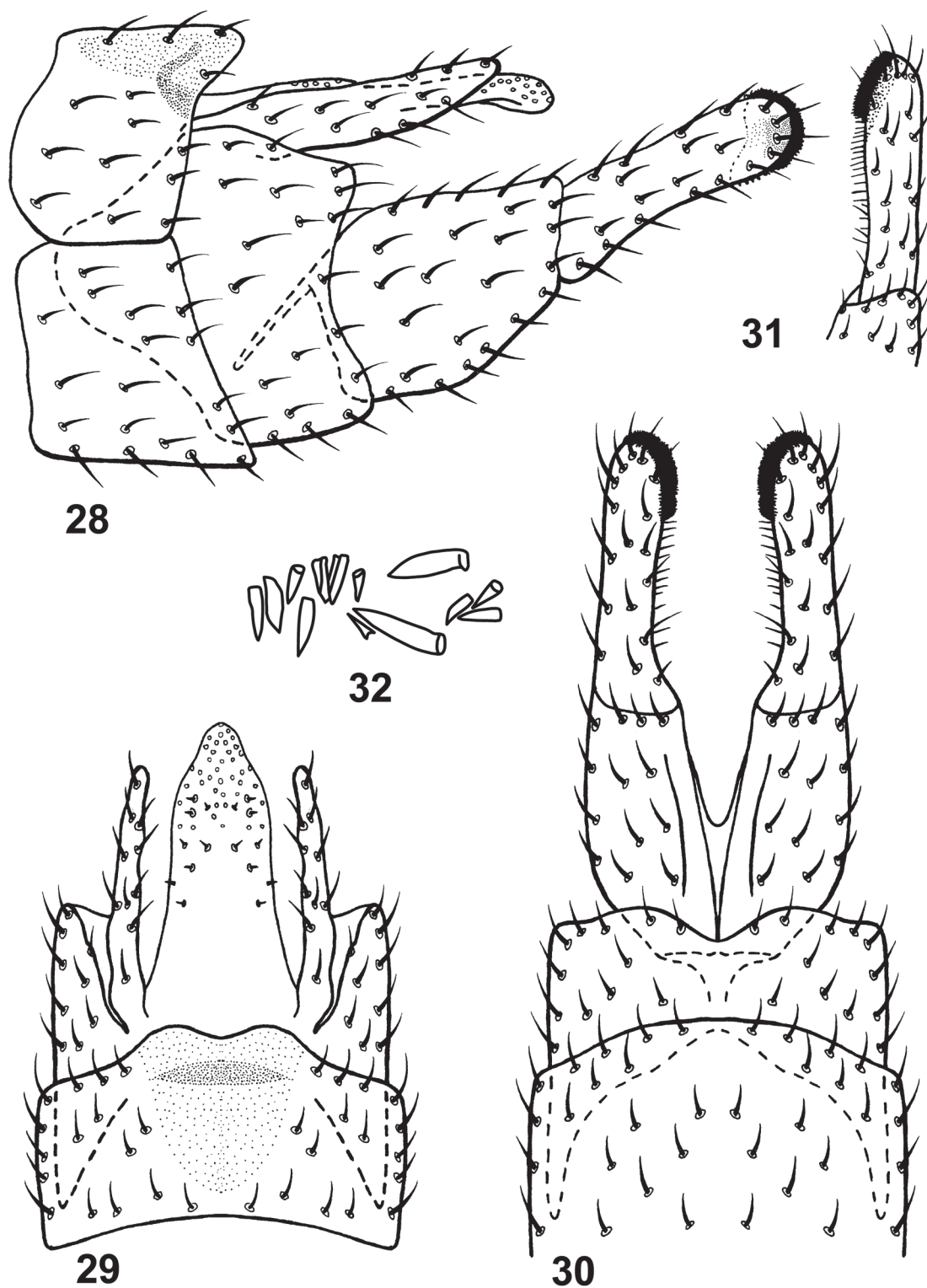




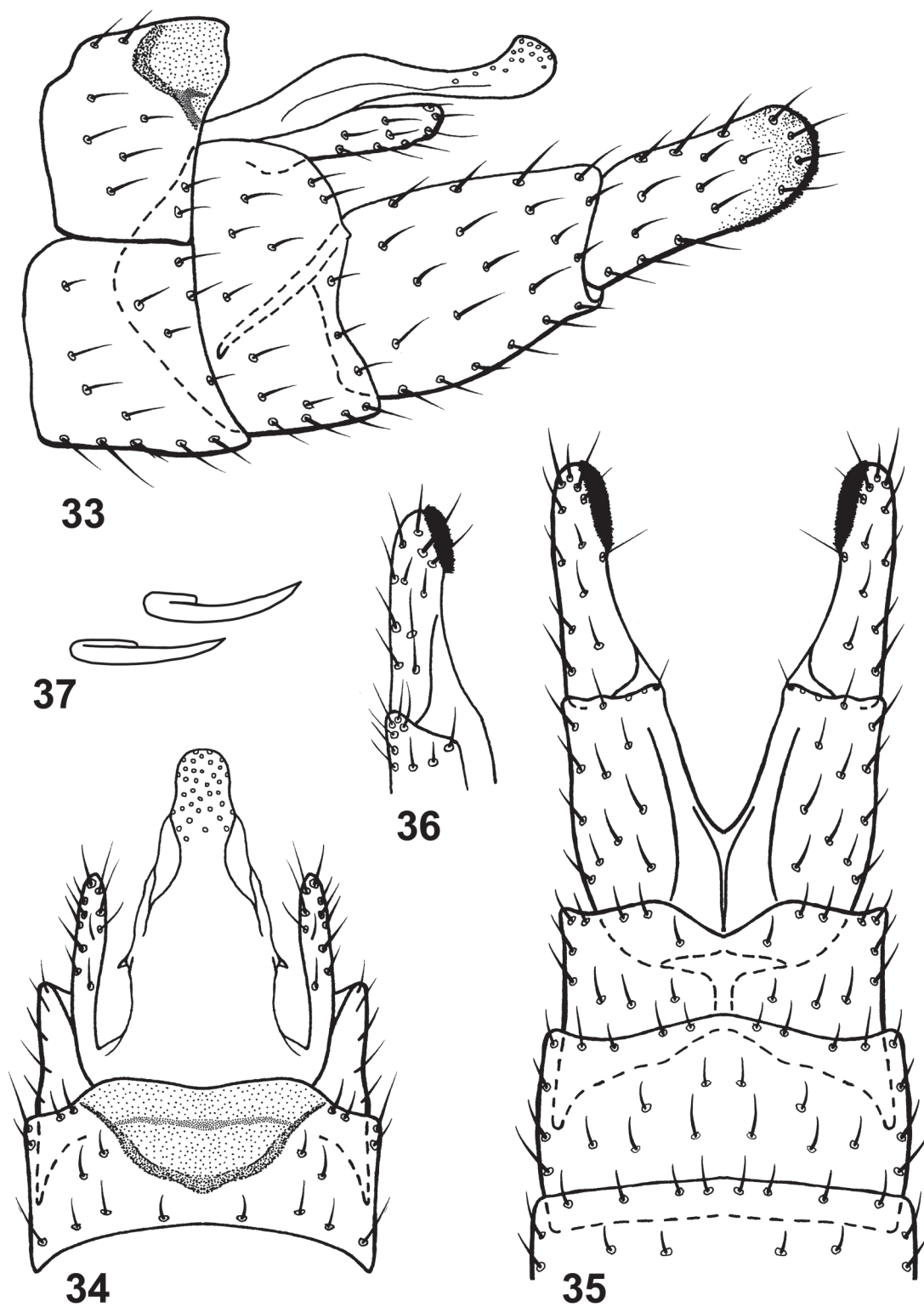
**FIGURES 18–22.** *Wormaldia fredycarol*, new species. Male genitalia: 18, left lateral; 19, dorsal; 20, ventral; 21, apical segment of left inferior appendage, dorsal; 22, phallic sclerites.



**FIGURES 23–27.** *Wormaldia luma* Bueno-Soria & Holzenthal. Male genitalia: 23, left lateral; 24, dorsal; 25, ventral; 26, apical segment of right inferior appendage, dorsal; 27, phallic sclerites.

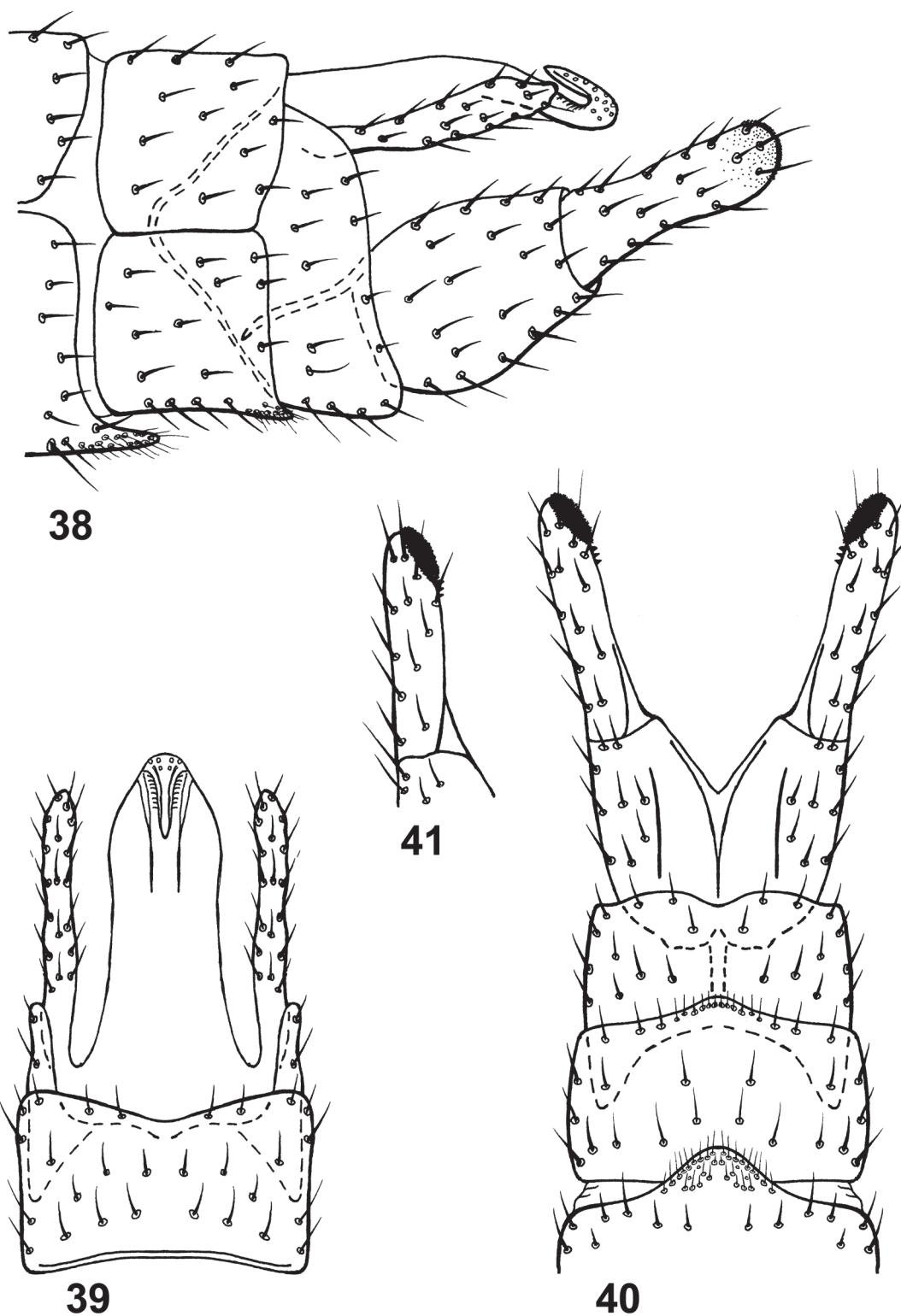


**FIGURES 28–32.** *Wormaldia maesi*, new species. Male genitalia: 28, left lateral; 29, dorsal; 30, ventral; 31, apical segment of left inferior appendage, dorsal; 32, phallic sclerites.

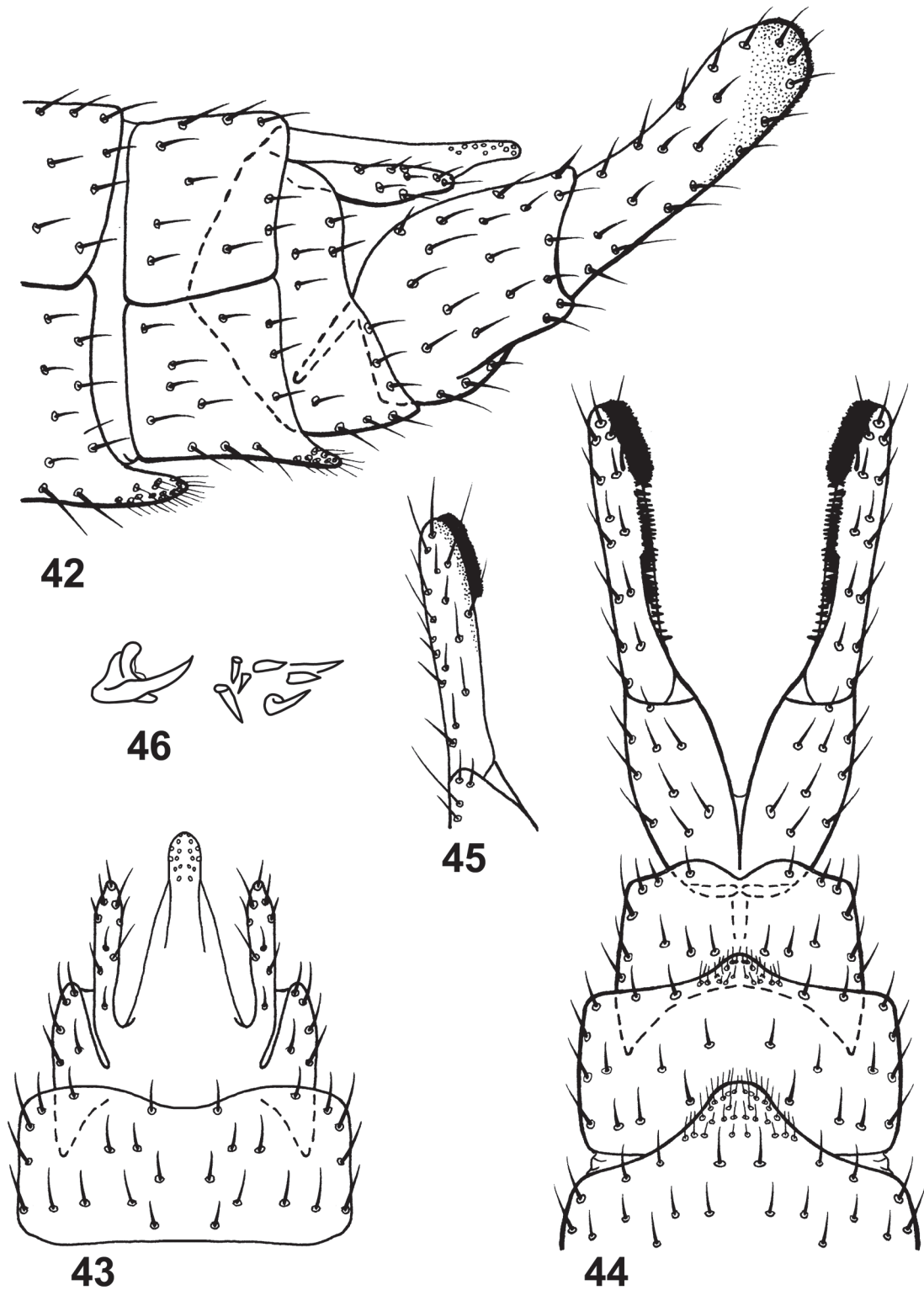


**FIGURES 33–37.** *Wormaldia palma* Flint. Male genitalia: 33, left lateral; 34, dorsal; 35, ventral; 36, apical segment of right inferior appendage, dorsal; 37, phallic sclerites.

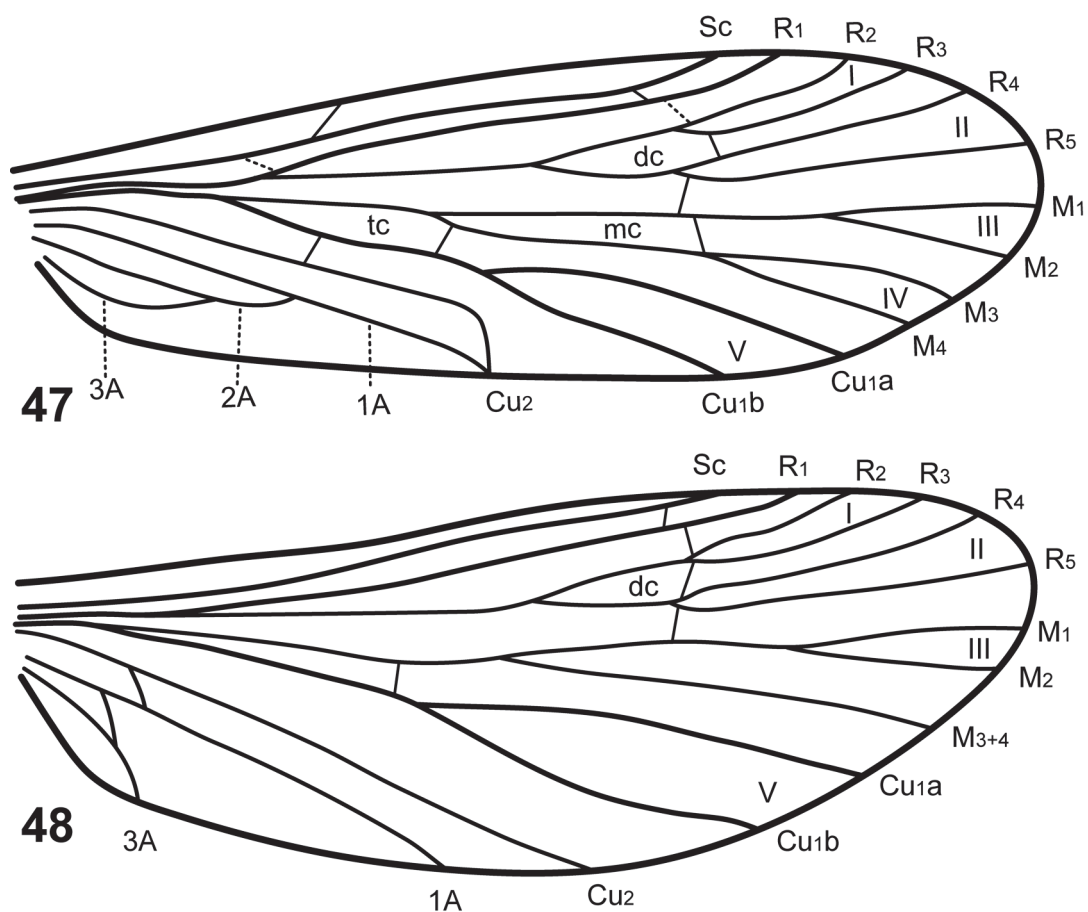




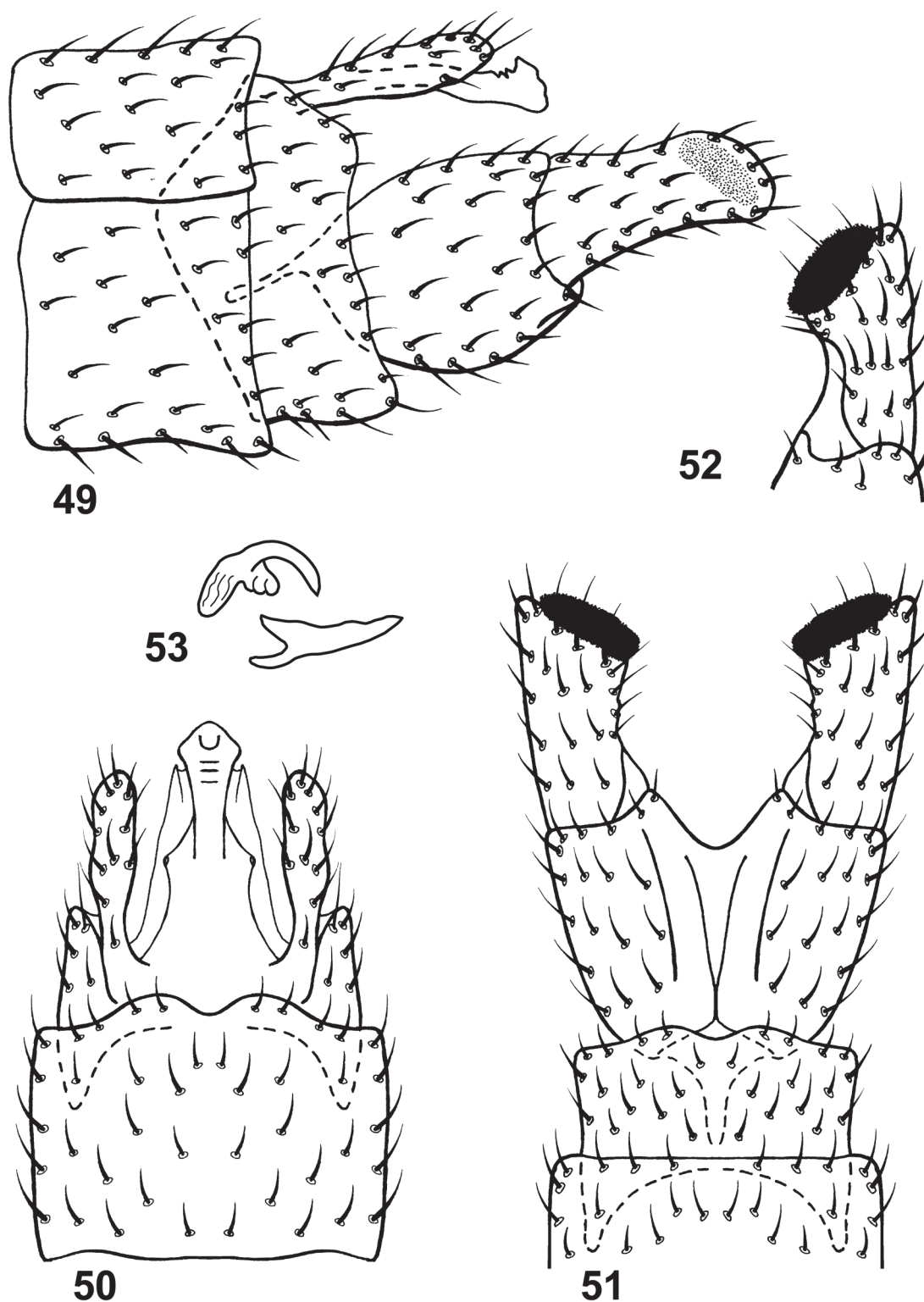
**FIGURES 38–41.** *Wormaldia dampfi* Ross & King. Male genitalia: 38, left lateral; 39, dorsal; 40, ventral; 41, apical segment of right inferior appendage, dorsal.



**FIGURES 42–46.** *Wormaldia endonima* Ross & King. Male genitalia: 42, left lateral; 43, dorsal; 44, ventral; 45, apical segment of right inferior appendage, dorsal; 46, phallic sclerites.

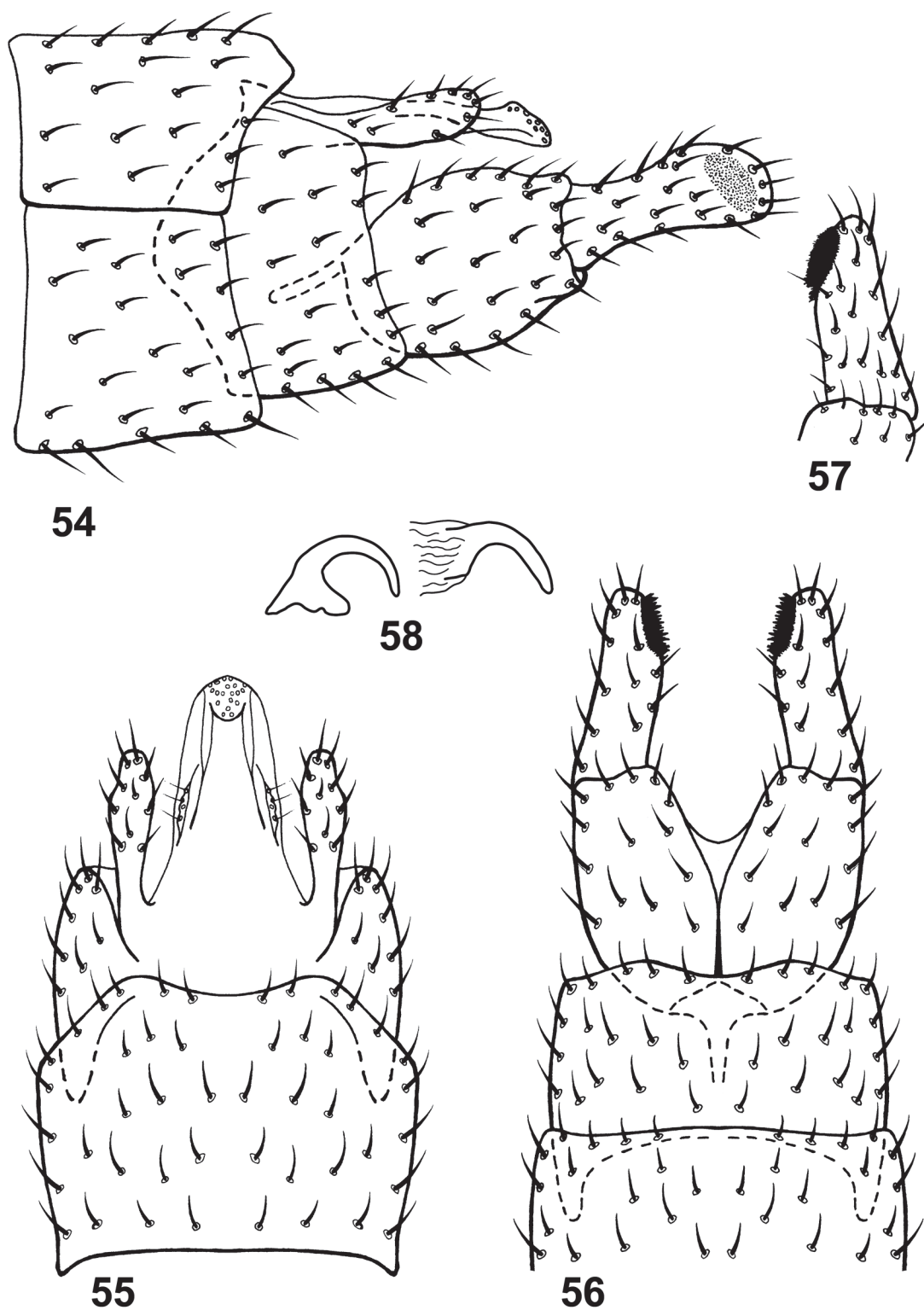


FIGURES 47–48. *Wormaldia endonima* Ross & King. Wings: 47, right forewing, dorsal; 48, right hind wing, dorsal.

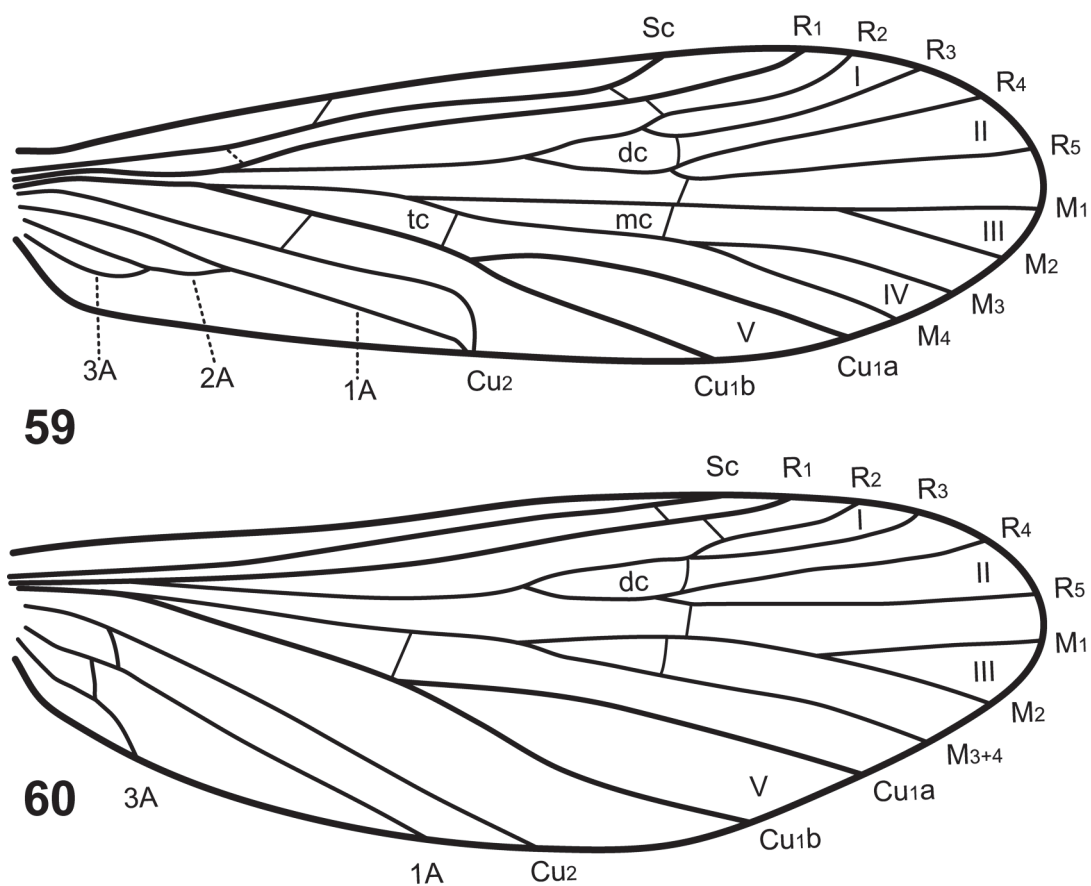


**FIGURES 49–53.** *Wormaldia chrismark*, new species. Male genitalia: 49, left lateral; 50, dorsal; 51, ventral; 52, apical segment of left inferior appendage, dorsal; 53, phallic sclerites.

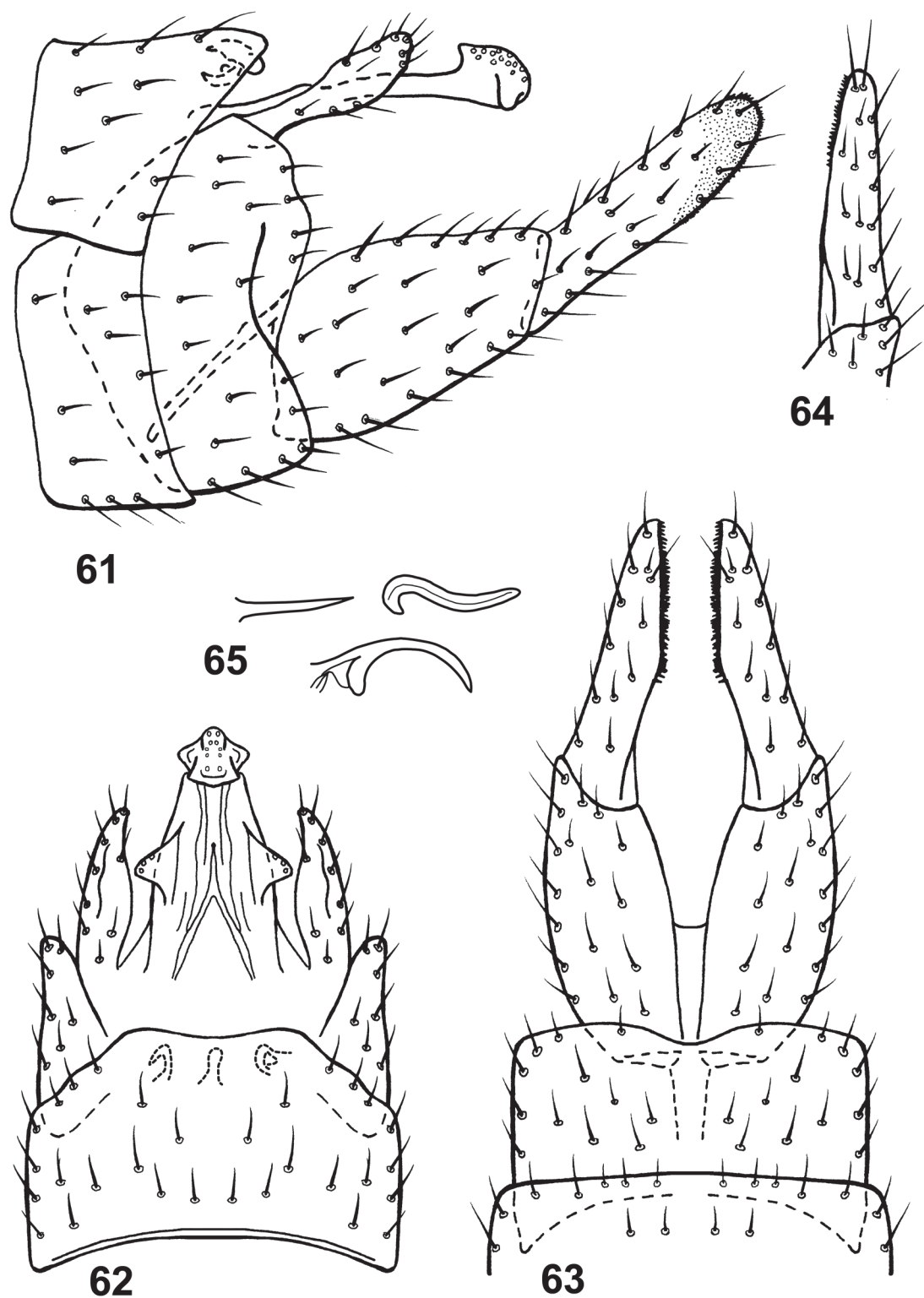




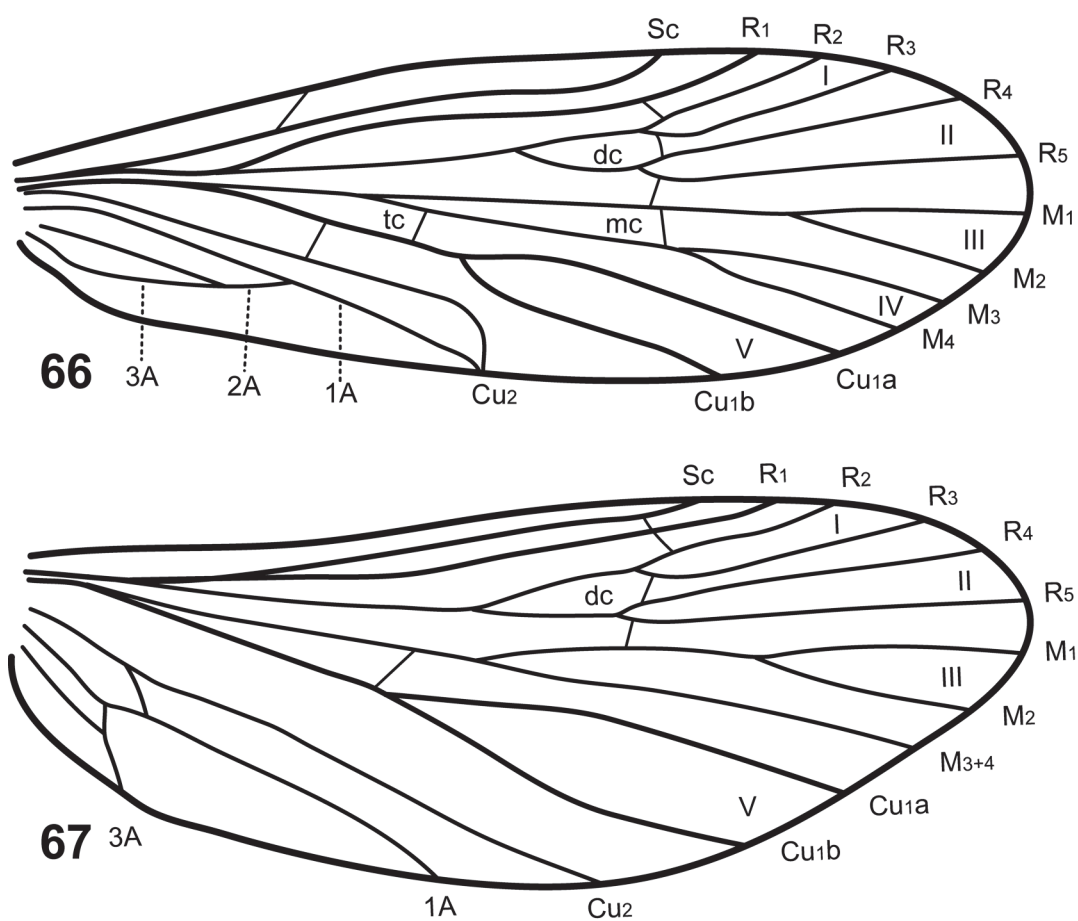
**FIGURES 54–58.** *Wormaldia flinti*, new species. Male genitalia: 54, left lateral; 55, dorsal; 56, ventral; 57, apical segment of left inferior appendage, dorsal; 58, phallic sclerites.



**FIGURES 59–60.** *Wormaldia flinti*, new species. Wings: 59, right forewing, dorsal; 60, right hind wing, dorsal.

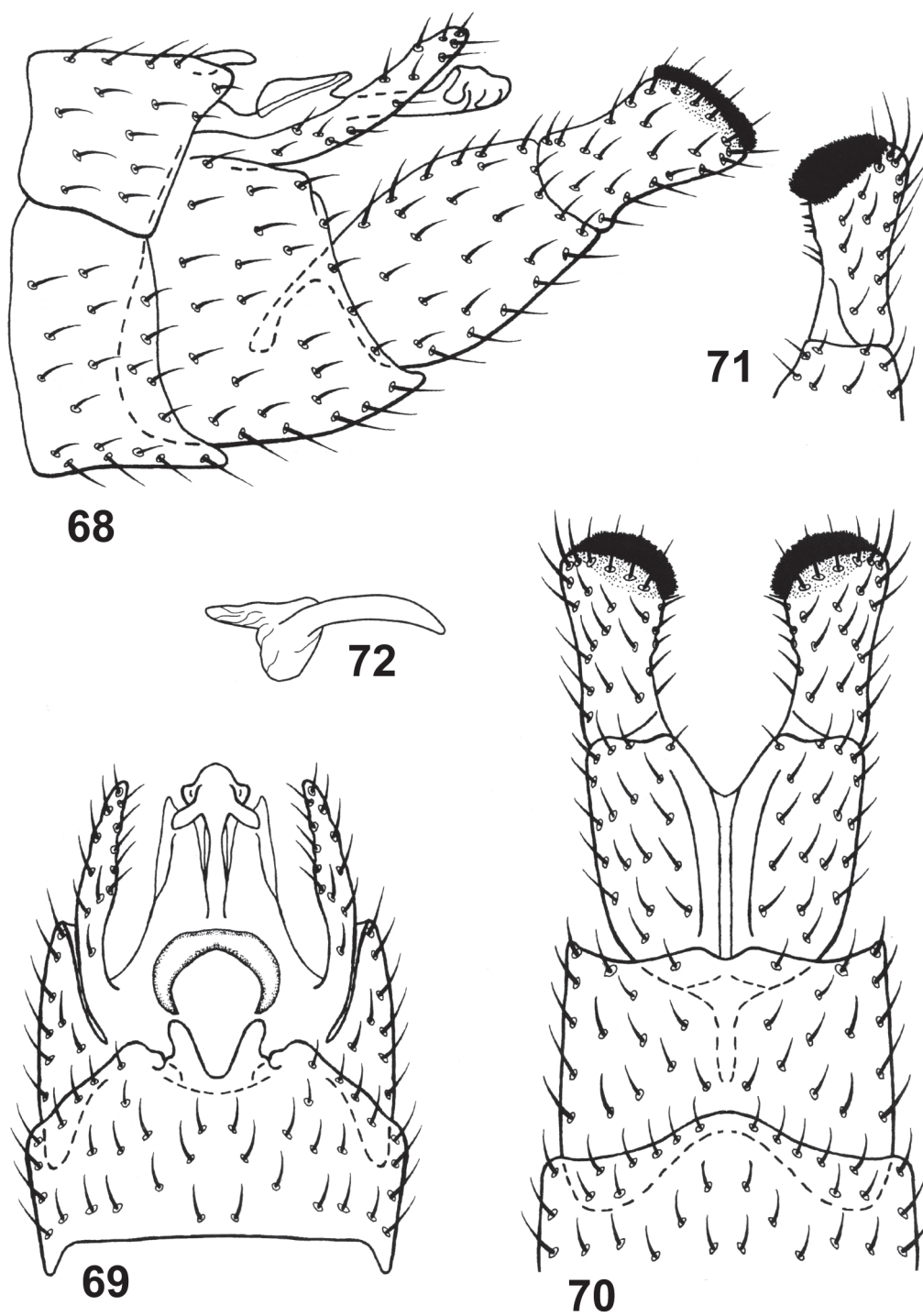


**FIGURES 61–65.** *Wormaldia esperonis* Ross & King. Male genitalia: 61, left lateral; 62, dorsal; 63, ventral; 64, apical segment of left inferior appendage, dorsal; 65, phallic sclerites.

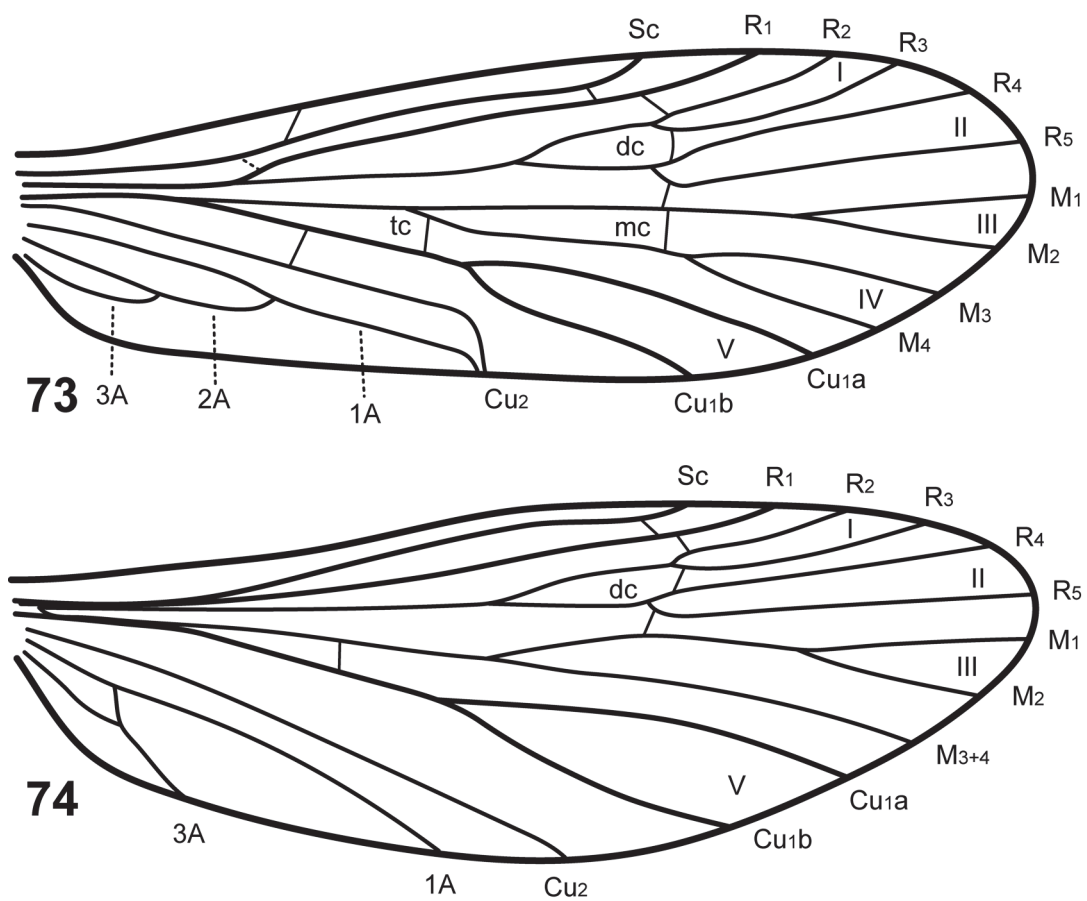


**FIGURES 66–67.** *Wormaldia esperonis* Ross & King. Wings:: 66, right forewing, dorsal; 67, right hind wing, dorsal.

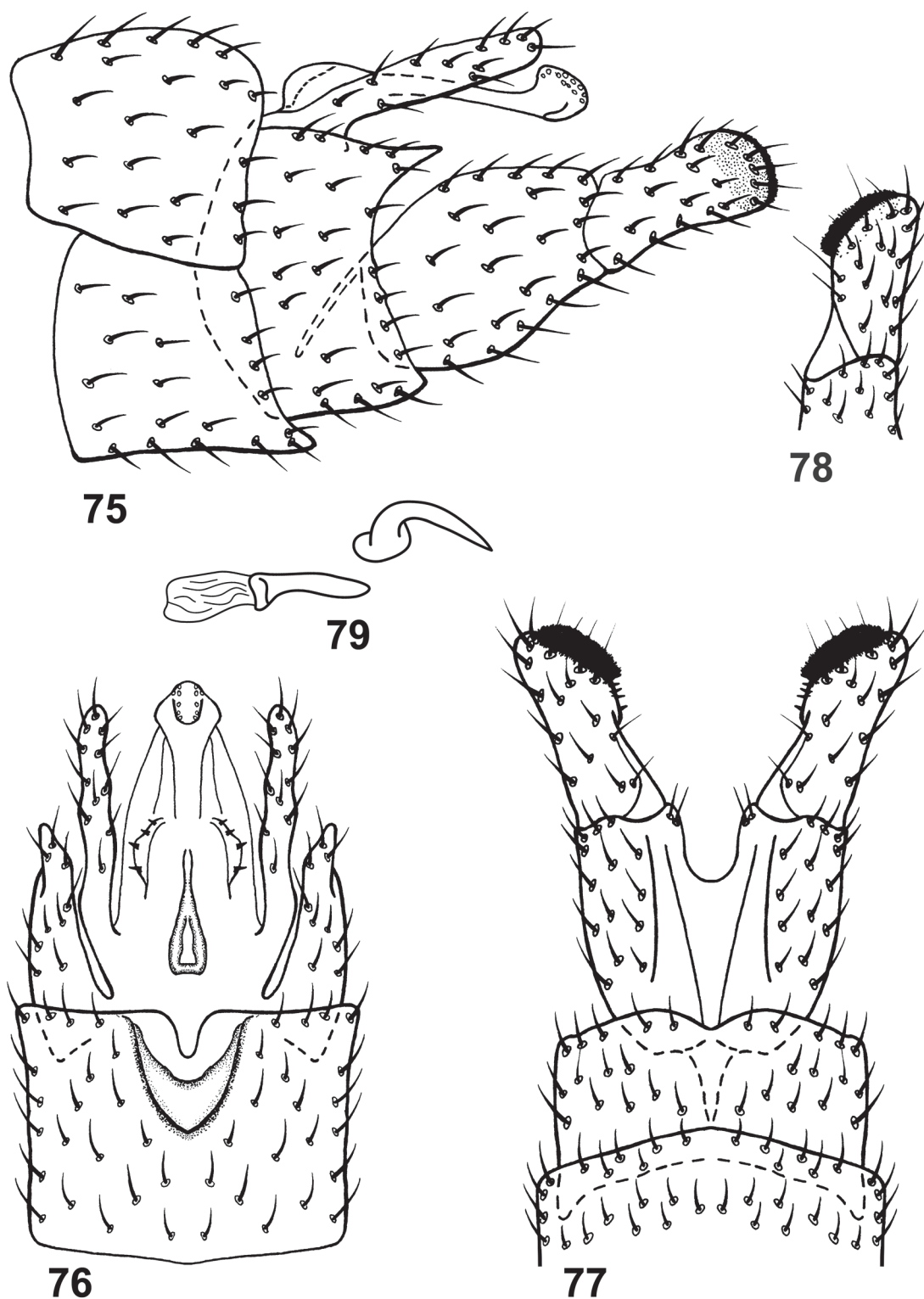




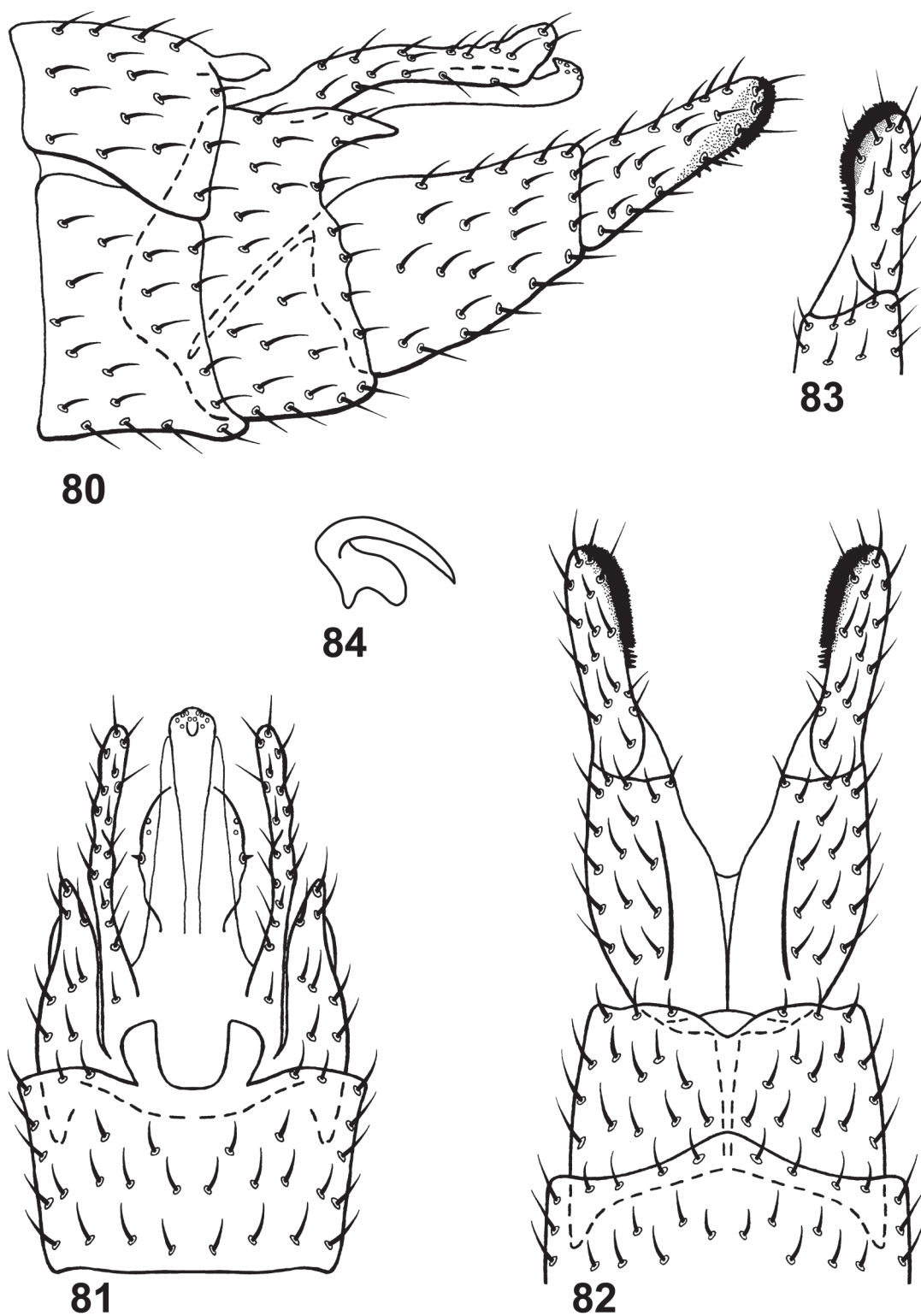
**FIGURES 68–72.** *Wormaldia araujoi*, new species. Male genitalia: 68, left lateral; 69, dorsal; 70, ventral; 71, apical segment of left inferior appendage, dorsal; 72, phallic sclerite, left lateral.



**FIGURES 73–74.** *Wormaldia araujoi*, new species. Wings: 73, right forewing, dorsal; 74, right hind wing, dorsal.

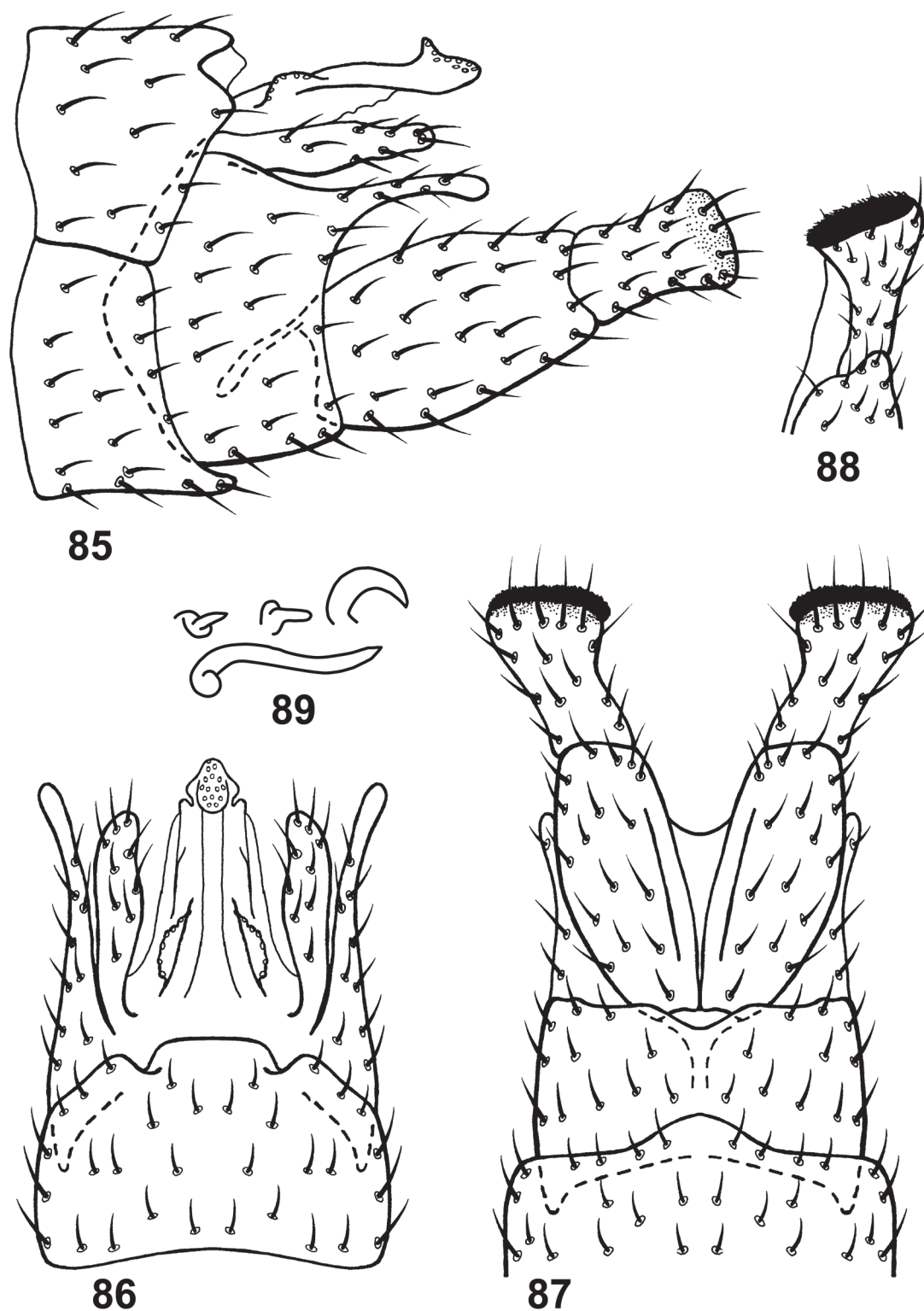


**FIGURES 75–79.** *Wormaldia dachiardiorum*, new species. Male genitalia: 75, left lateral; 76, dorsal; 77, ventral; 78, apical segment of left inferior appendage, dorsal; 79, phallic sclerites.

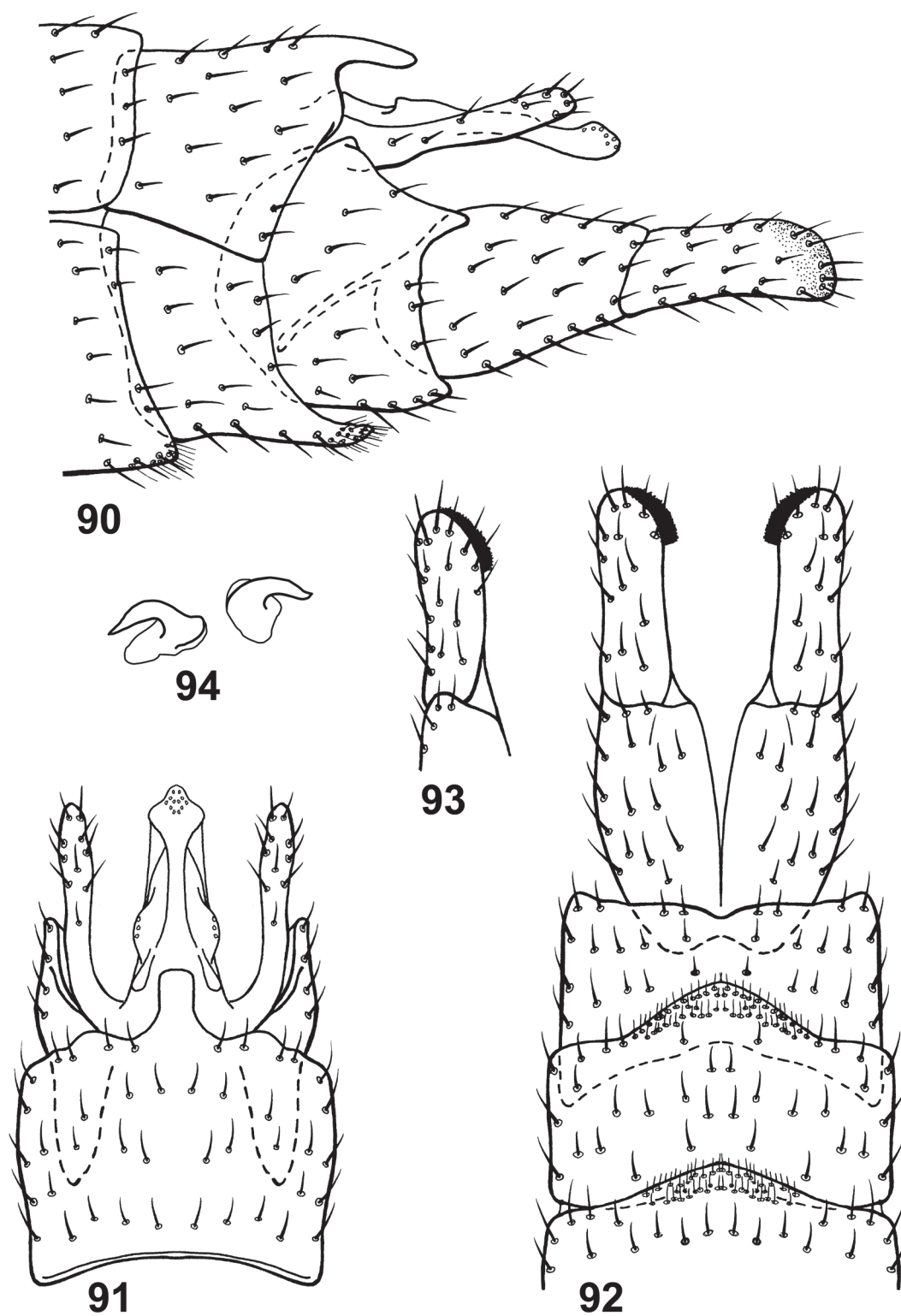


**FIGURES 80–84.** *Wormaldia aymara*, new species. Male genitalia: 80, left lateral; 81, dorsal; 82, ventral; 83, apical segment of left inferior appendage, dorsal; 84, phallic sclerite, left lateral.

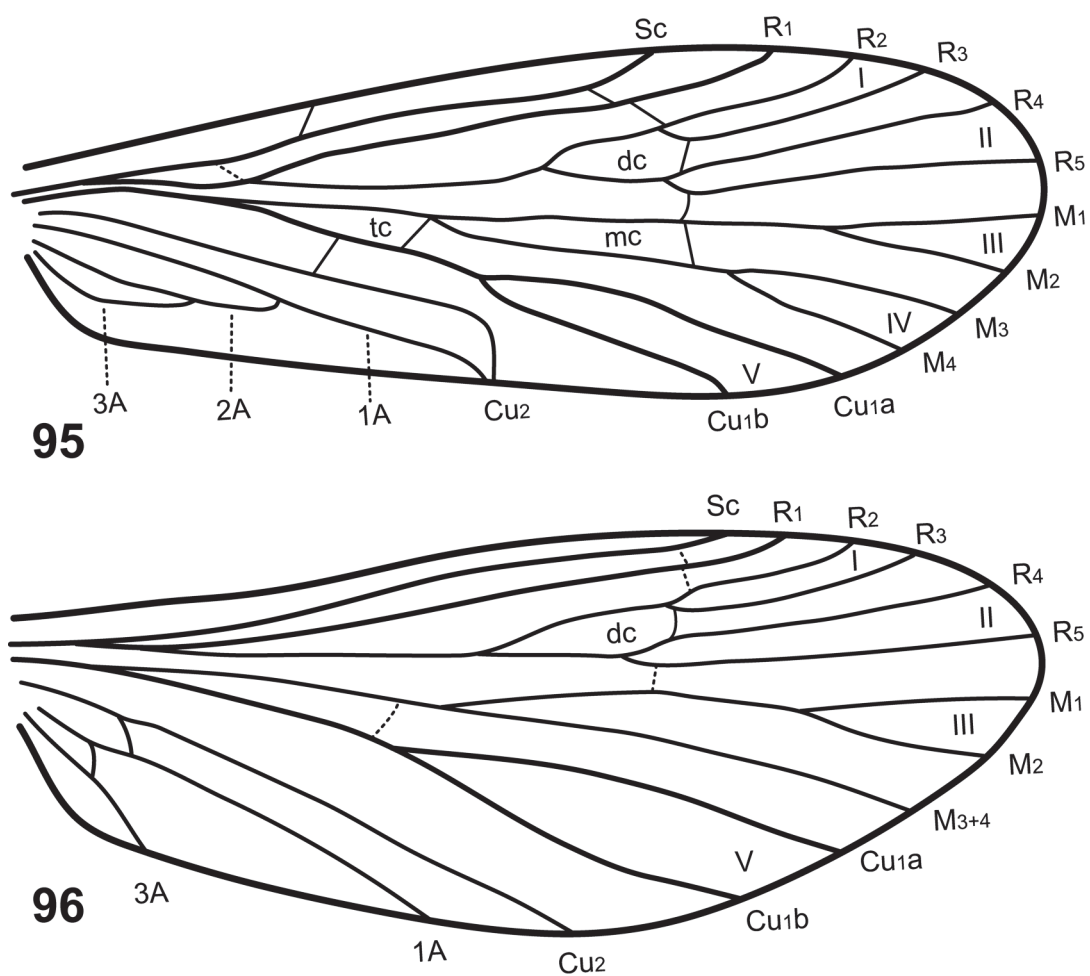




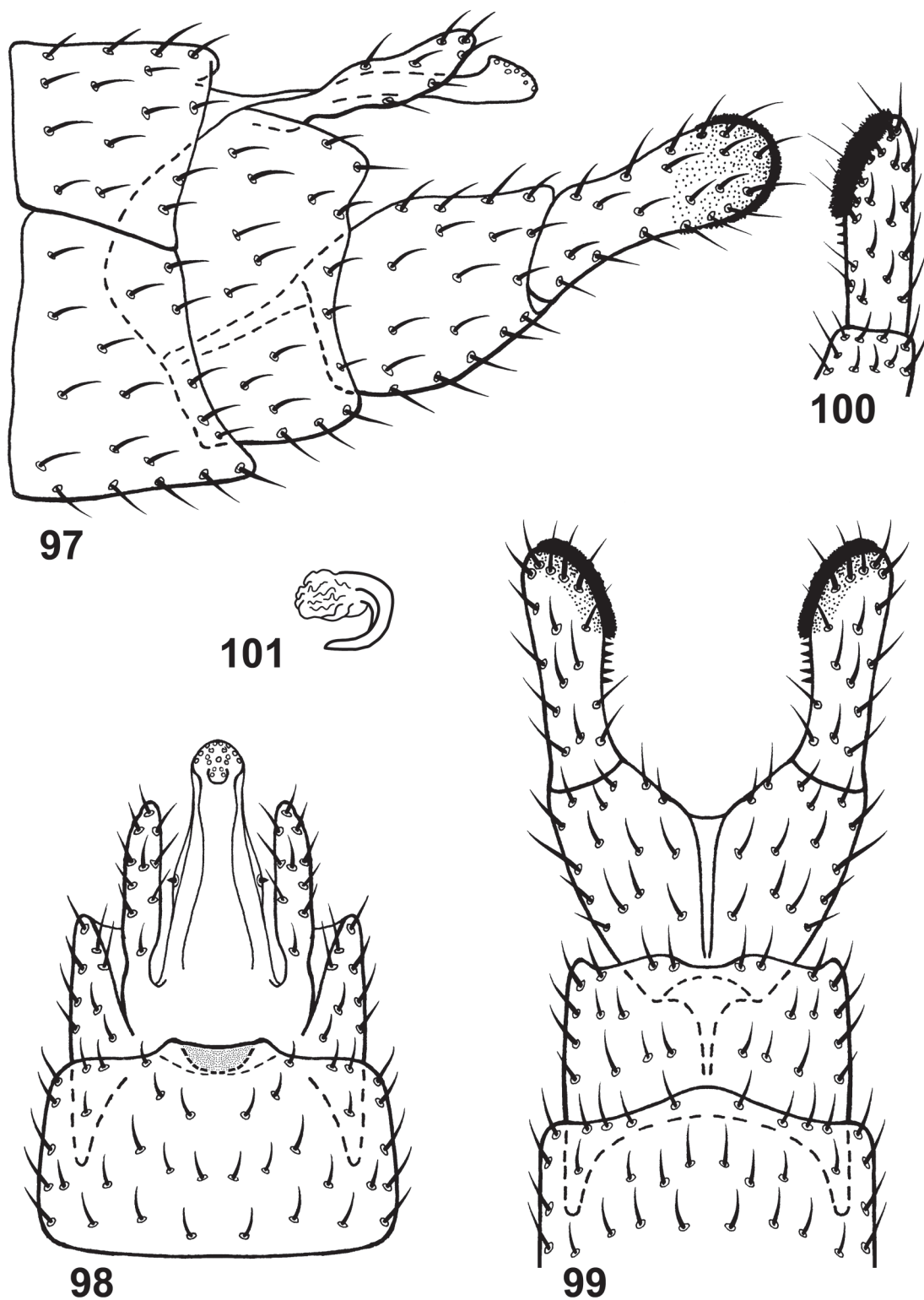
**FIGURES 85–89.** *Wormaldia inca*, new species. Male genitalia: 85, left lateral; 86, dorsal; 87, ventral; 88, apical segment of left inferior appendage, dorsal; 89, phallic sclerites.



**FIGURES 90–94.** *Wormaldia insignis* (Martynov). Male genitalia: 90, left lateral; 91, dorsal; 92, ventral; 93, apical segment of right inferior appendage, dorsal; 94, phallic sclerites.

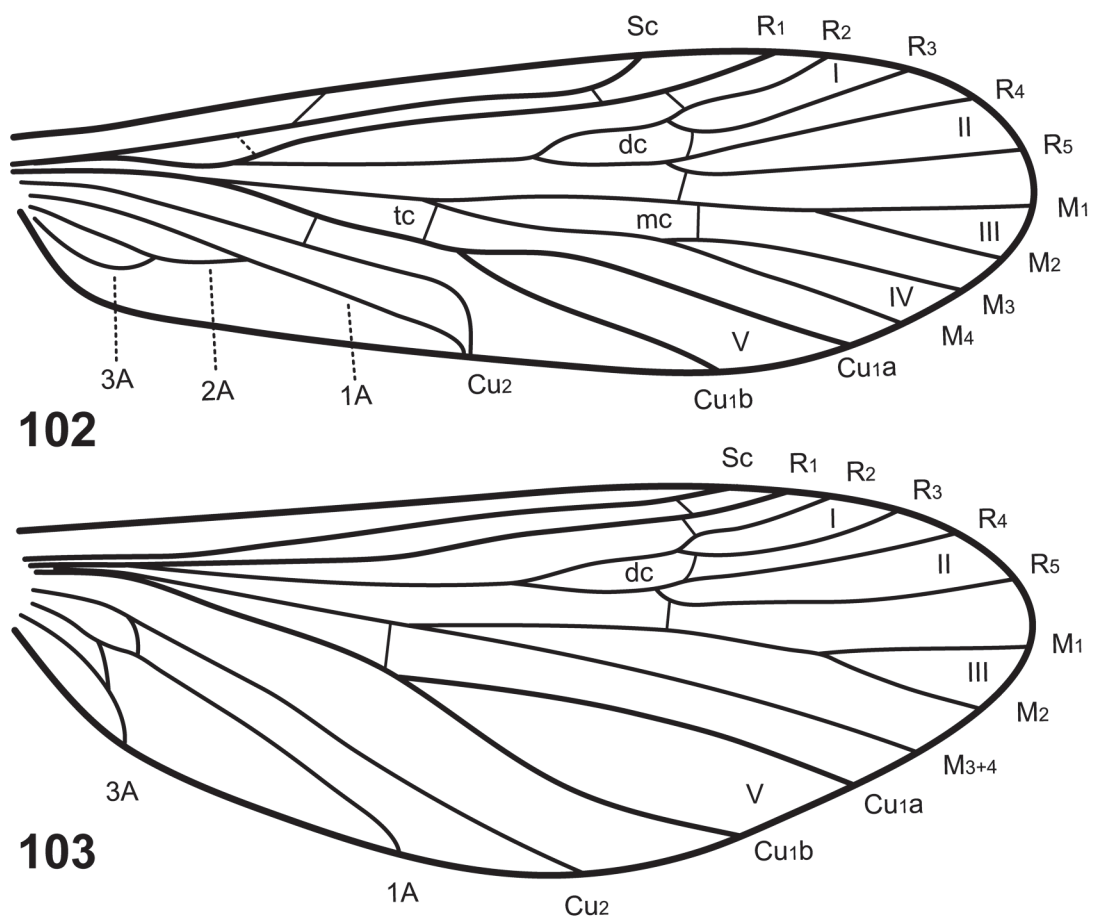


**FIGURES 95–96.** *Wormaldia insignis* (Martynov). Wings: 95, right forewing, dorsal; 96, right hind wing, dorsal.

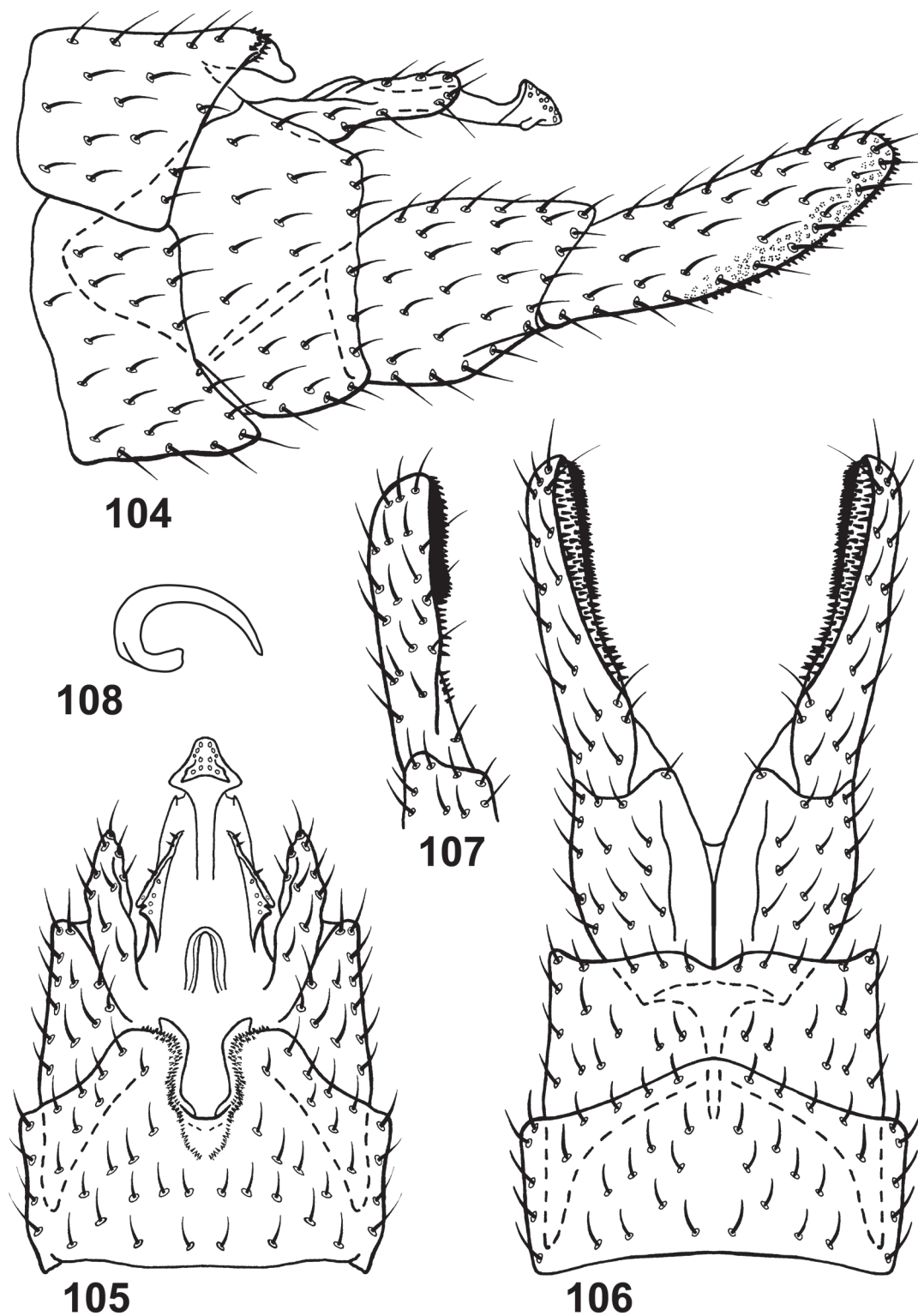


**FIGURES 97–101.** *Wormaldia tupacamara*, new species. Male genitalia: 97, left lateral; 98, dorsal; 99, ventral; 100, apical segment of left inferior appendage, dorsal; 101, phallic sclerite, left lateral.

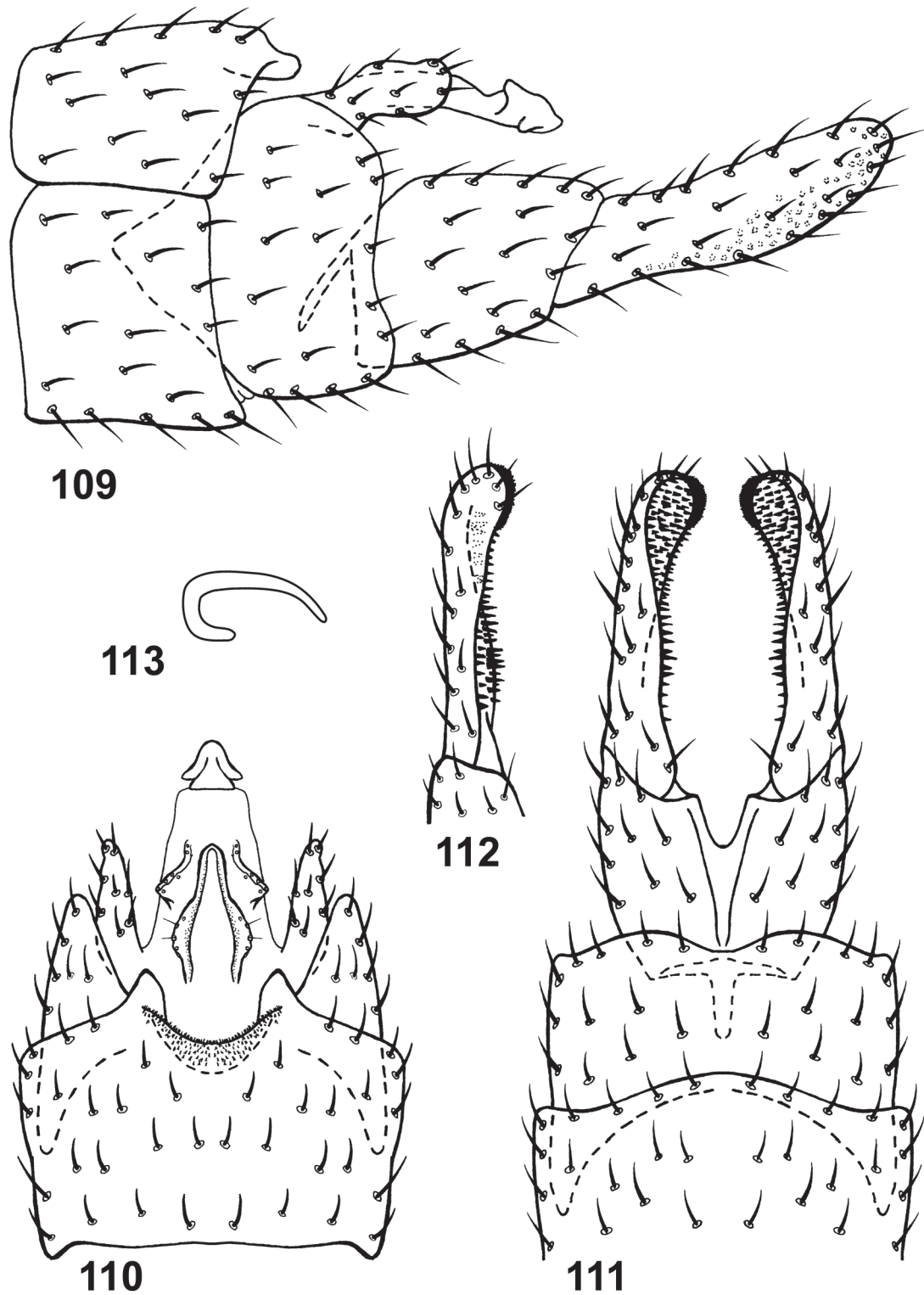




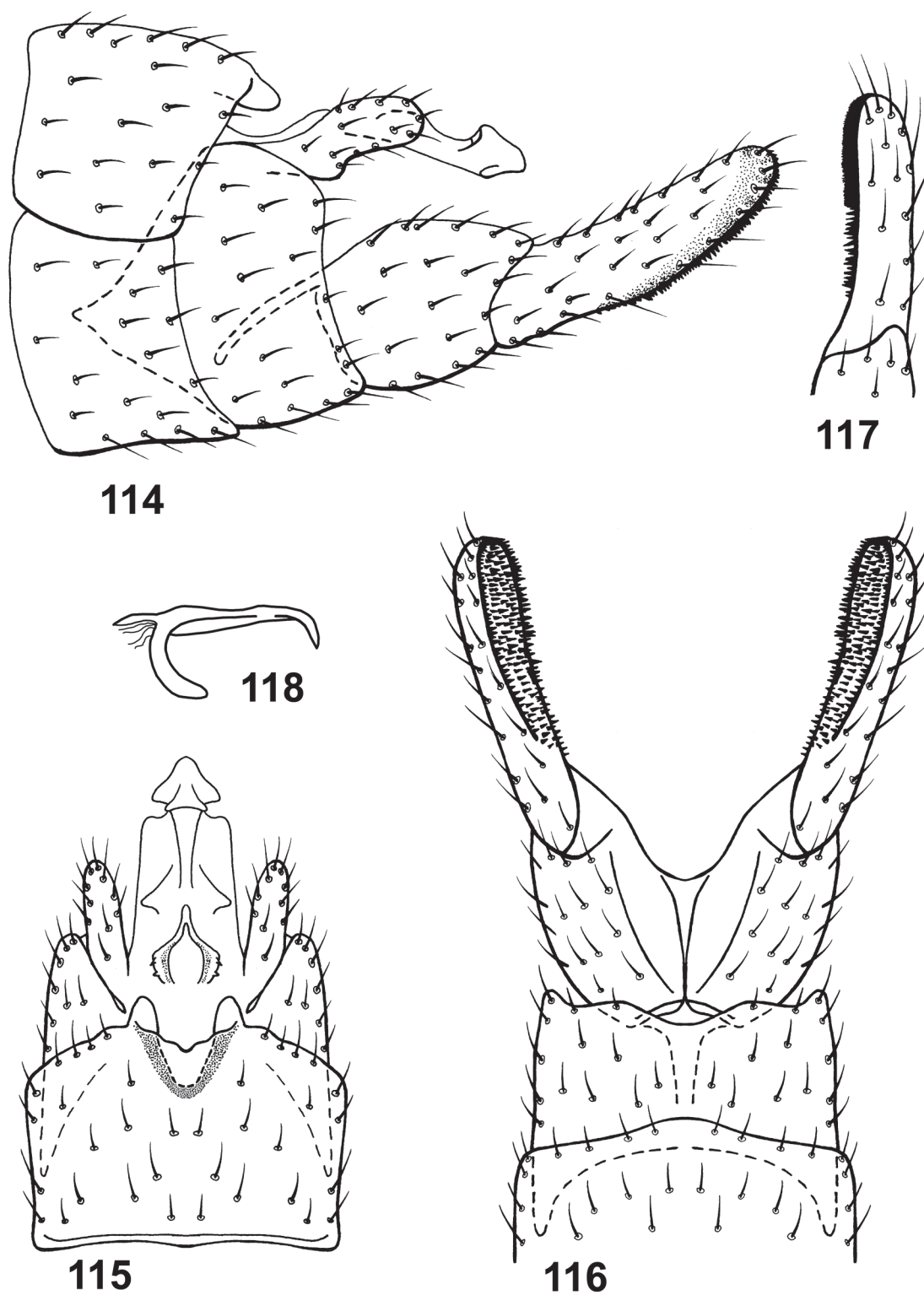
**FIGURES 102–103.** *Wormaldia tupacamara*, new species. Wings: 102, right forewing, dorsal; 103, right hind wing, dorsal.



**FIGURES 104–108.** *Wormaldia gallardoi*, new species. Male genitalia: 104, left lateral; 105, dorsal; 106, ventral; 107, apical segment of right inferior appendage, dorsal; 108, phallic sclerite, left lateral.

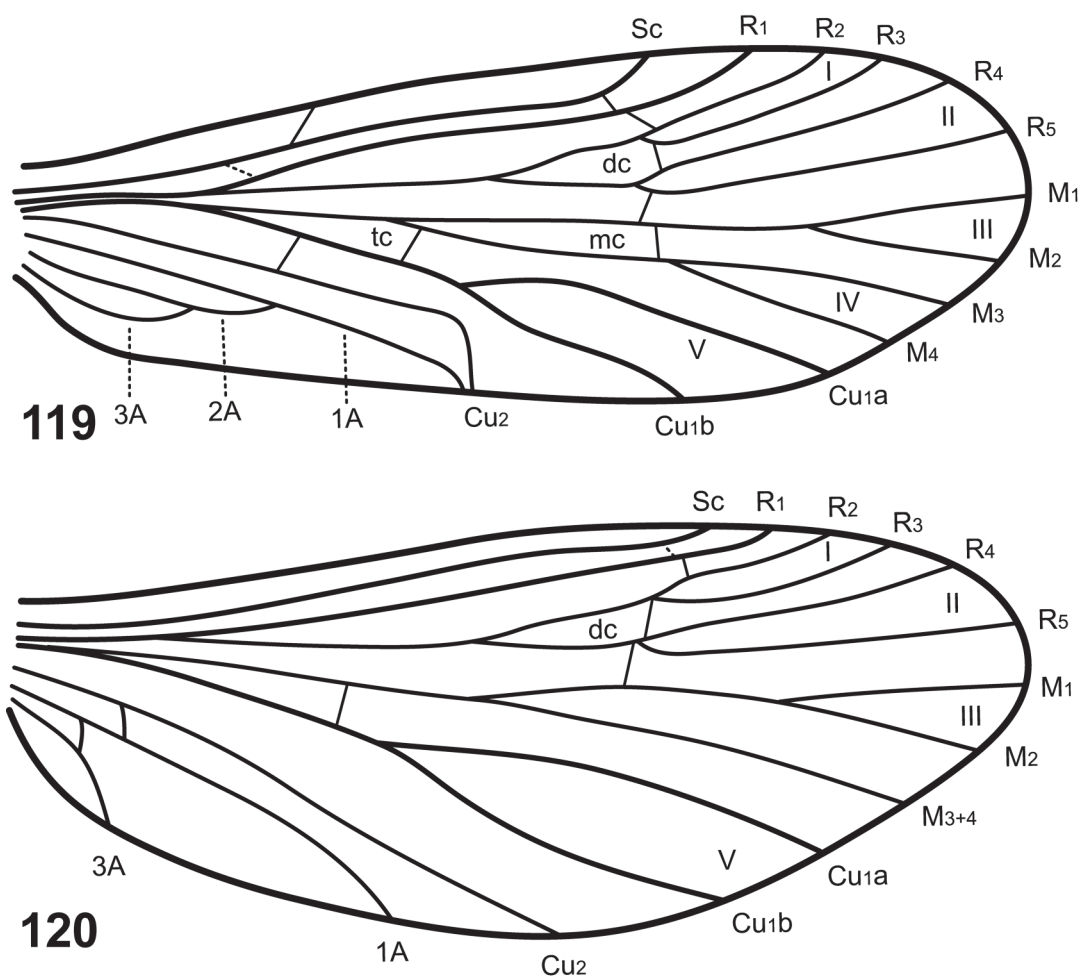


**FIGURES 109–113.** *Wormaldia andrea*, new species. Male genitalia: 109, left lateral; 110, dorsal; 111, ventral; 112, apical segment of right inferior appendage, dorsal; 113, phallic sclerite, left lateral.

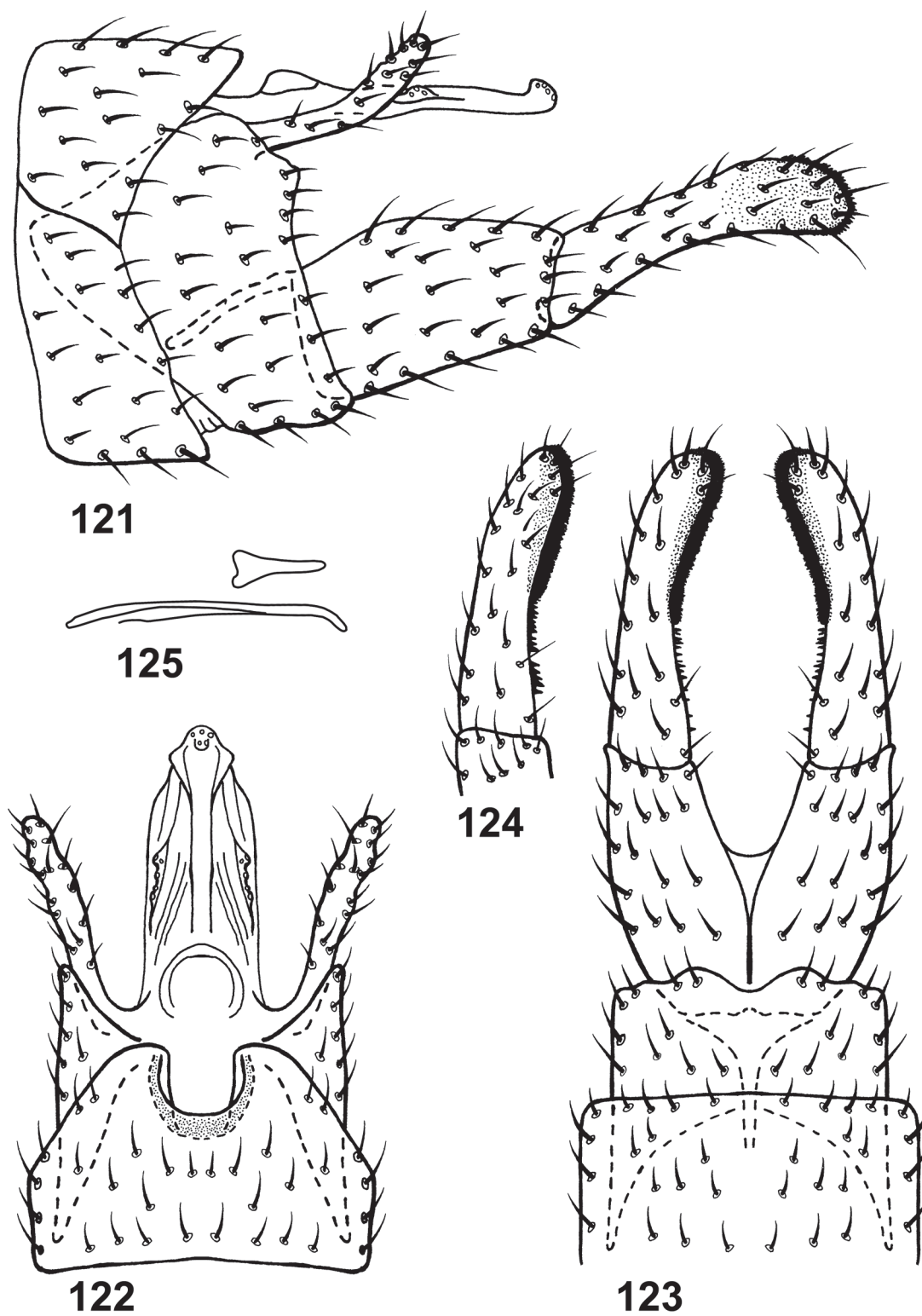


**FIGURES 114–118.** *Wormaldia prolixa* Flint. Male genitalia: 114, left lateral; 115, dorsal; 116, ventral; 117, apical segment of left inferior appendage, dorsal; 118, phallic sclerite, left lateral.

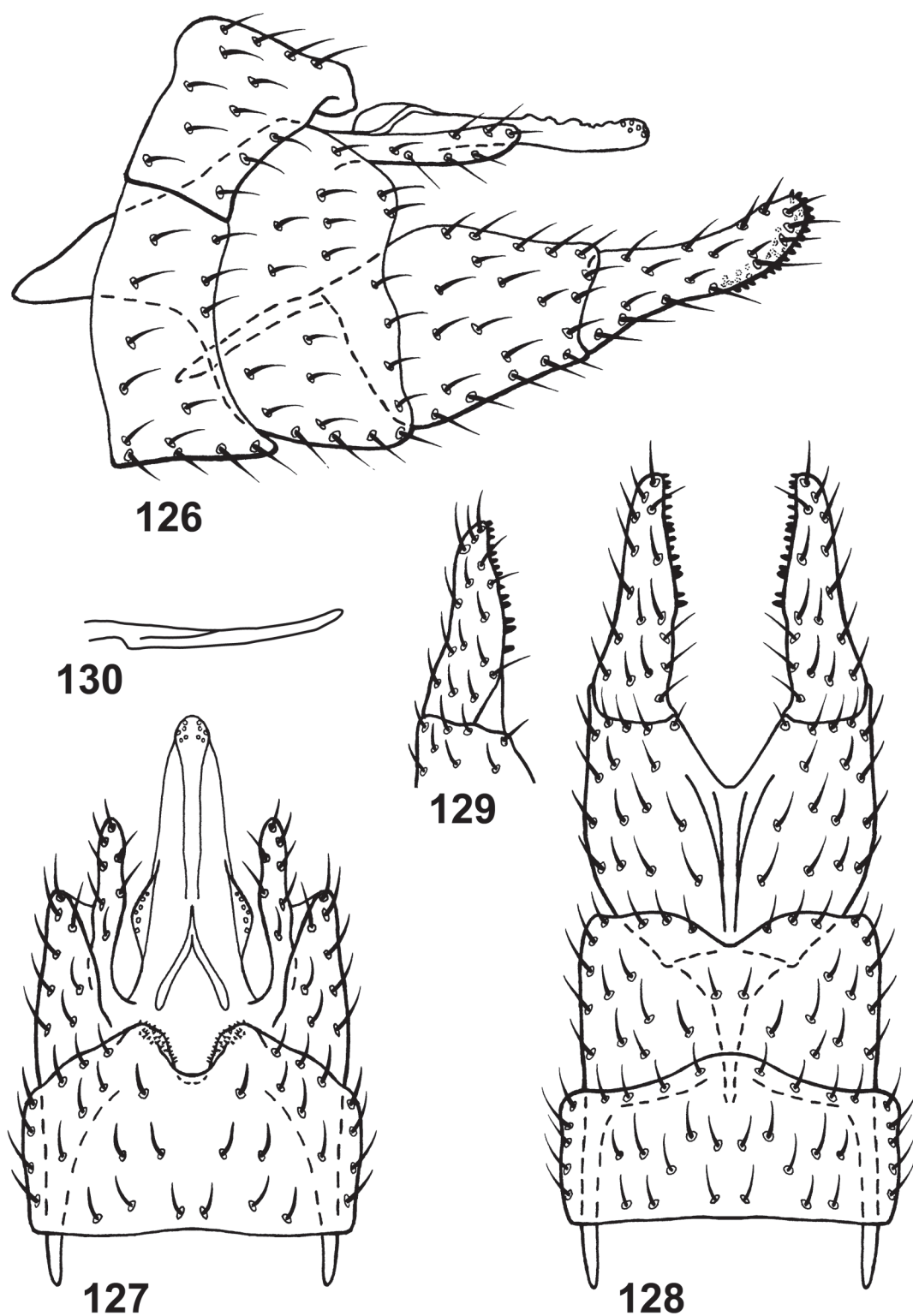




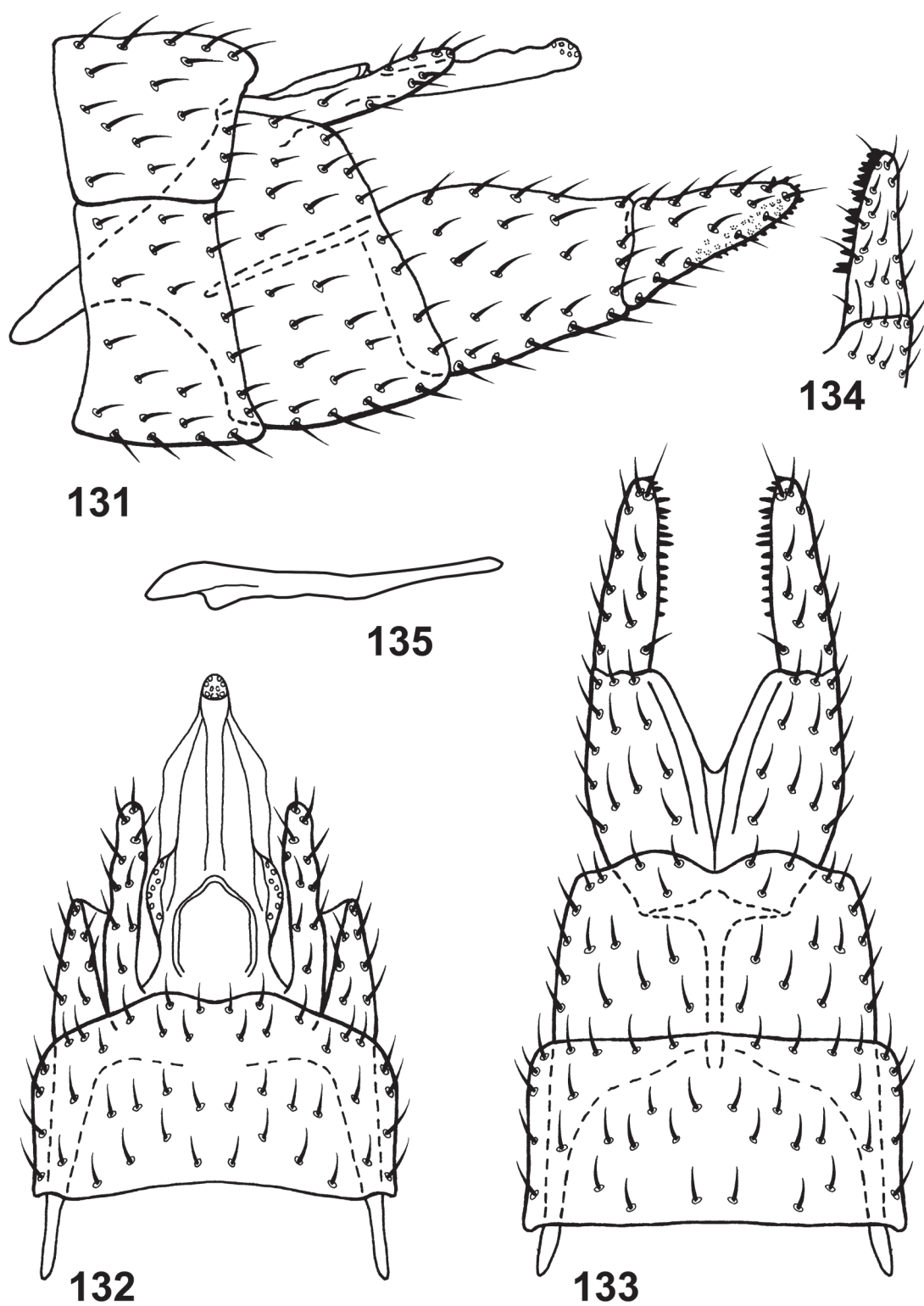
FIGURES 119–120. *Wormaldia prolixa* Flint. Wings: 119, right forewing, dorsal; 120, right hind wing, dorsal.



**FIGURES 121–125.** *Wormaldia francovilla*, new species. Male genitalia: 121, left lateral; 122, dorsal; 123, ventral; 124, apical segment of right inferior appendage, dorsal; 125, phallic sclerites.

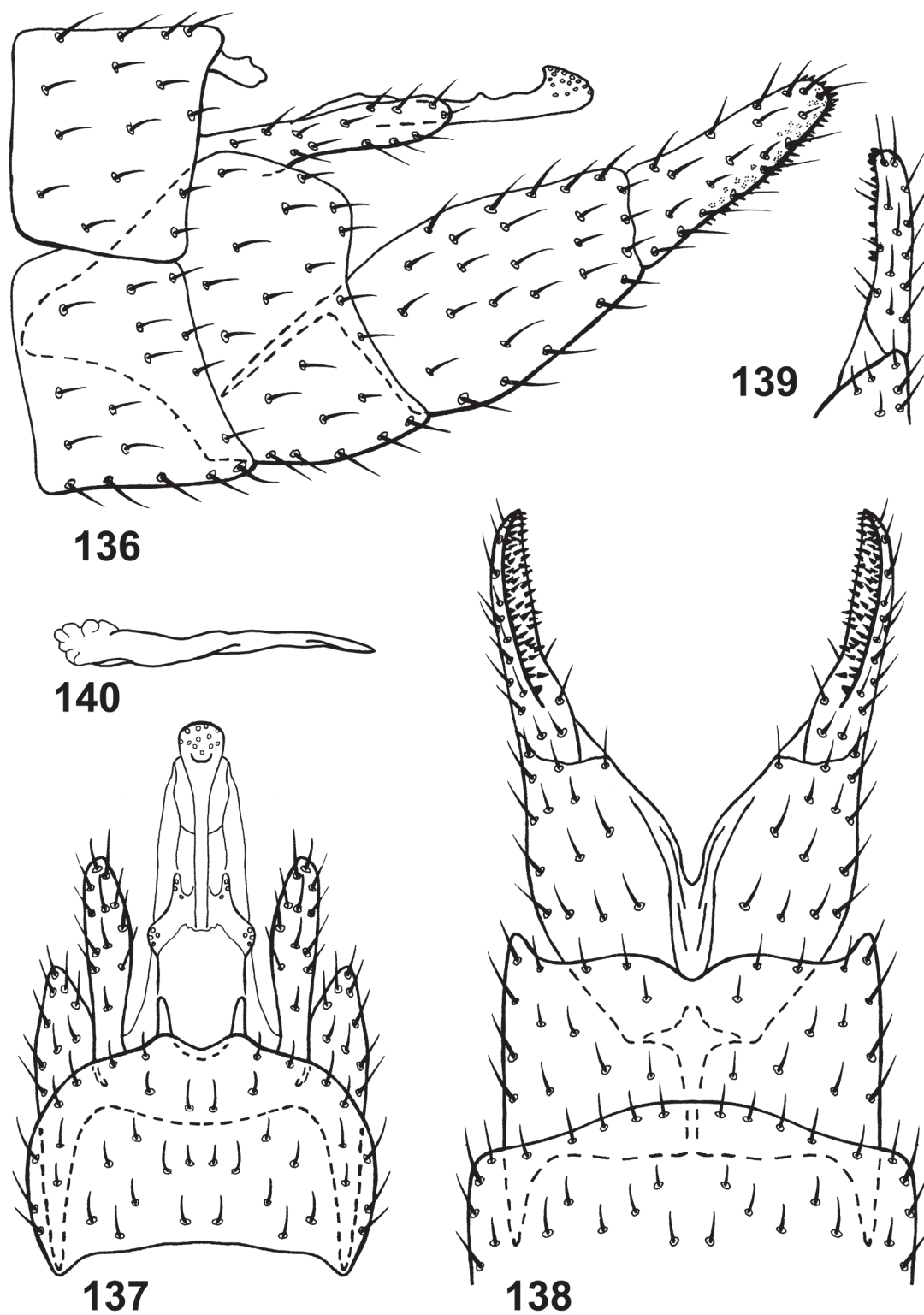


**FIGURES 126–130.** *Wormaldia imberti*, new species. Male genitalia: 126, left lateral; 127, dorsal; 128, ventral; 129, apical segment of right inferior appendage, dorsal; 130, phallic sclerite, left lateral.

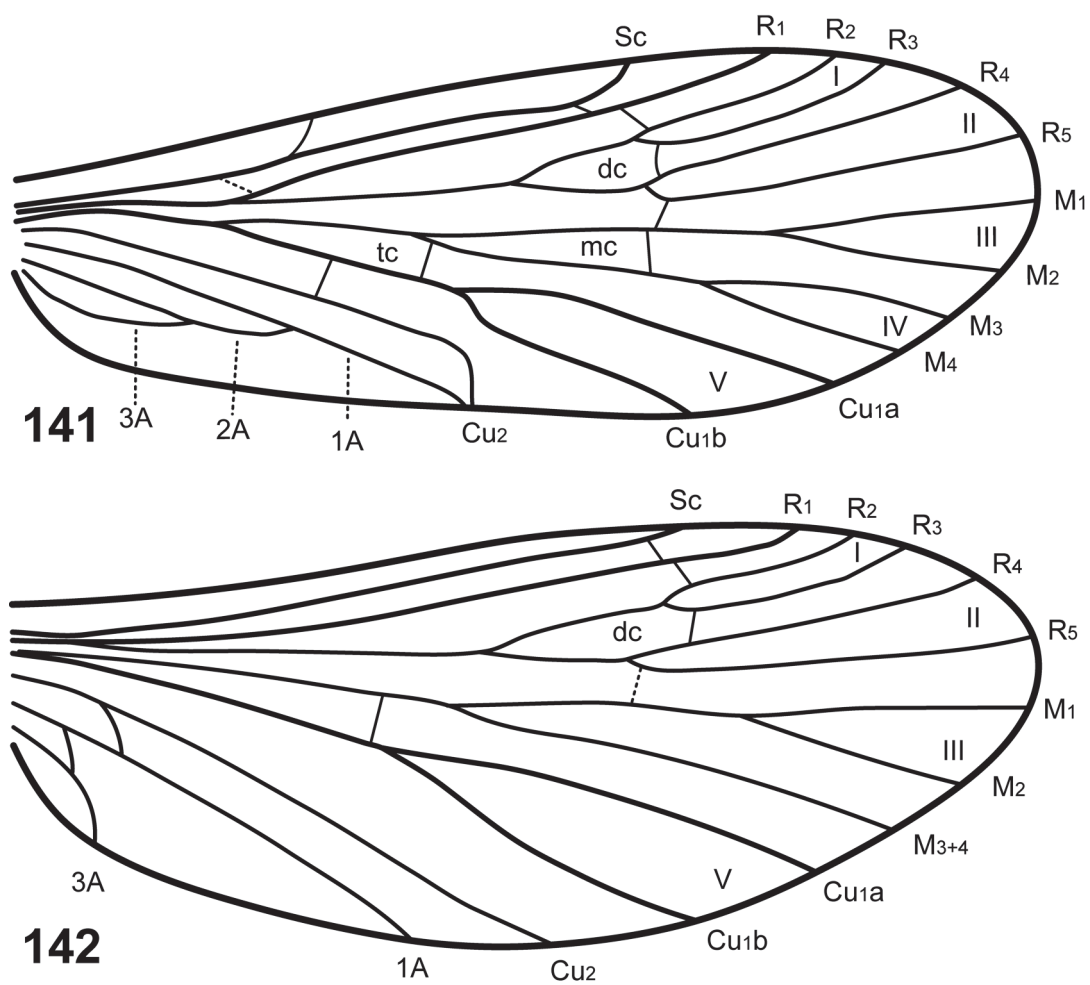


**FIGURES 131–135.** *Wormaldia contrerasi*, new species. Male genitalia: 131, left lateral; 132, dorsal; 133, ventral; 134, apical segment of left inferior appendage, dorsal; 135, phallic sclerite, left lateral.

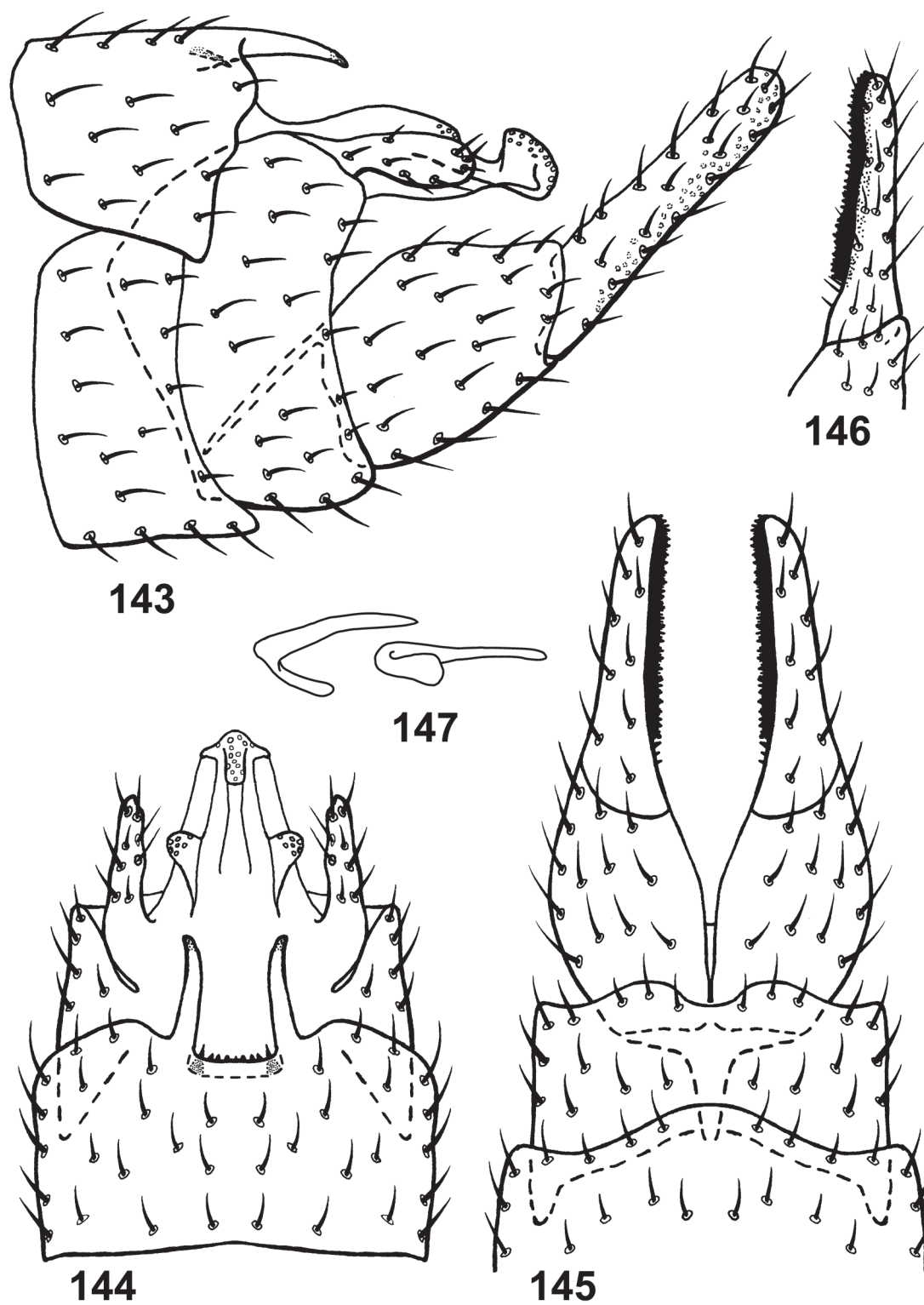




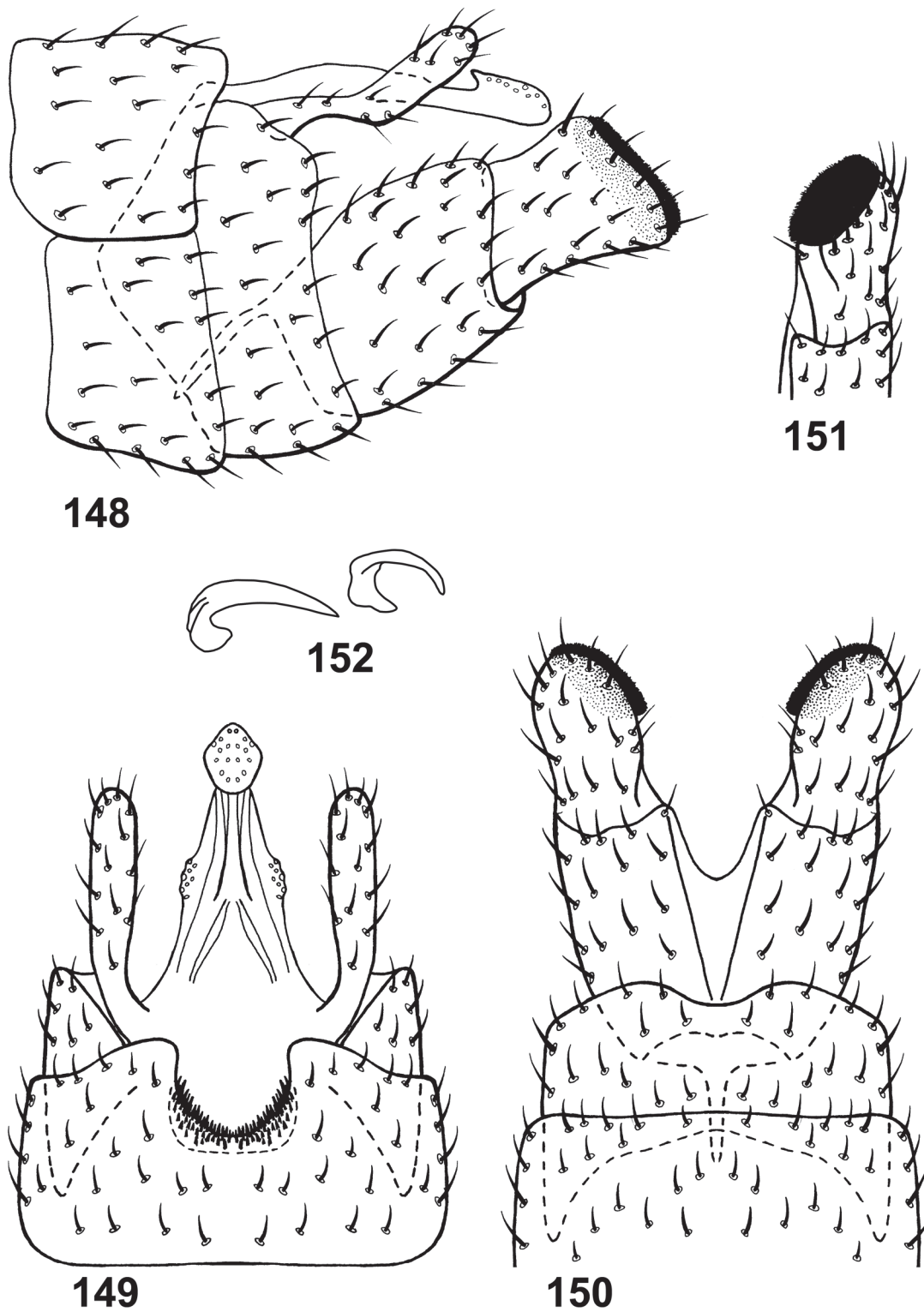
**FIGURES 136–140.** *Wormaldia machadorum*, new species. Male genitalia: 136, left lateral; 137, dorsal; 138, ventral; 139, apical segment of left inferior appendage, dorsal; 140, phallic sclerite, left lateral.



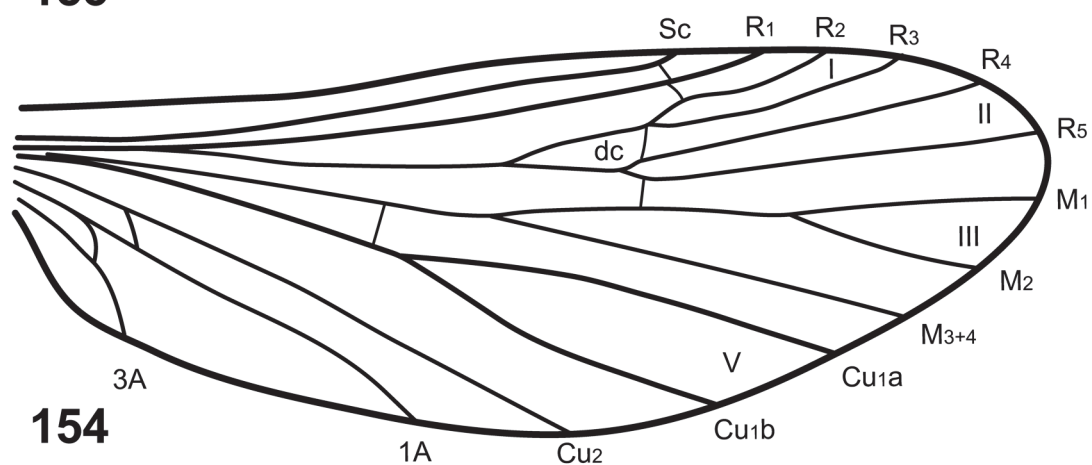
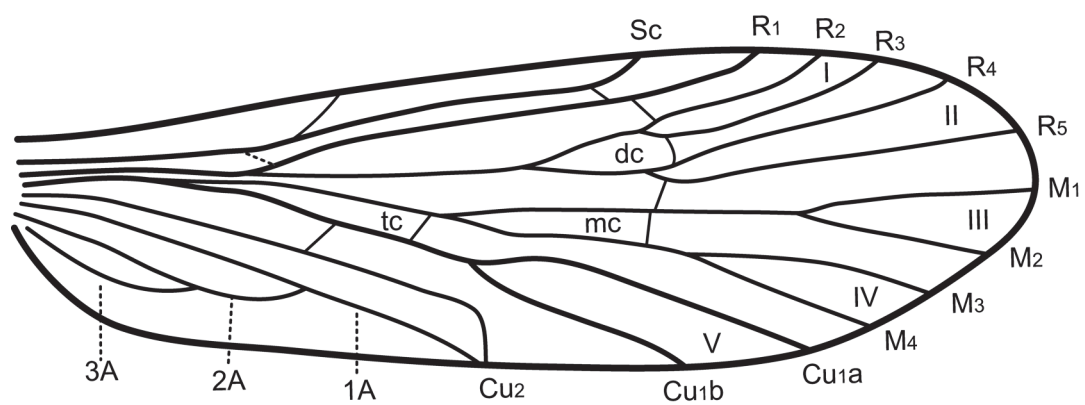
**FIGURES 141–142.** *Wormaldia machadorum*, new species. Wings: 141, right forewing, dorsal; 142, right hind wing, dorsal.



**FIGURES 143–147.** *Wormaldia zunigarceorum*, new species. Male genitalia: 143, left lateral; 144, dorsal; 145, ventral; 146, apical segment of left inferior appendage, dorsal; 147, phallic sclerites.

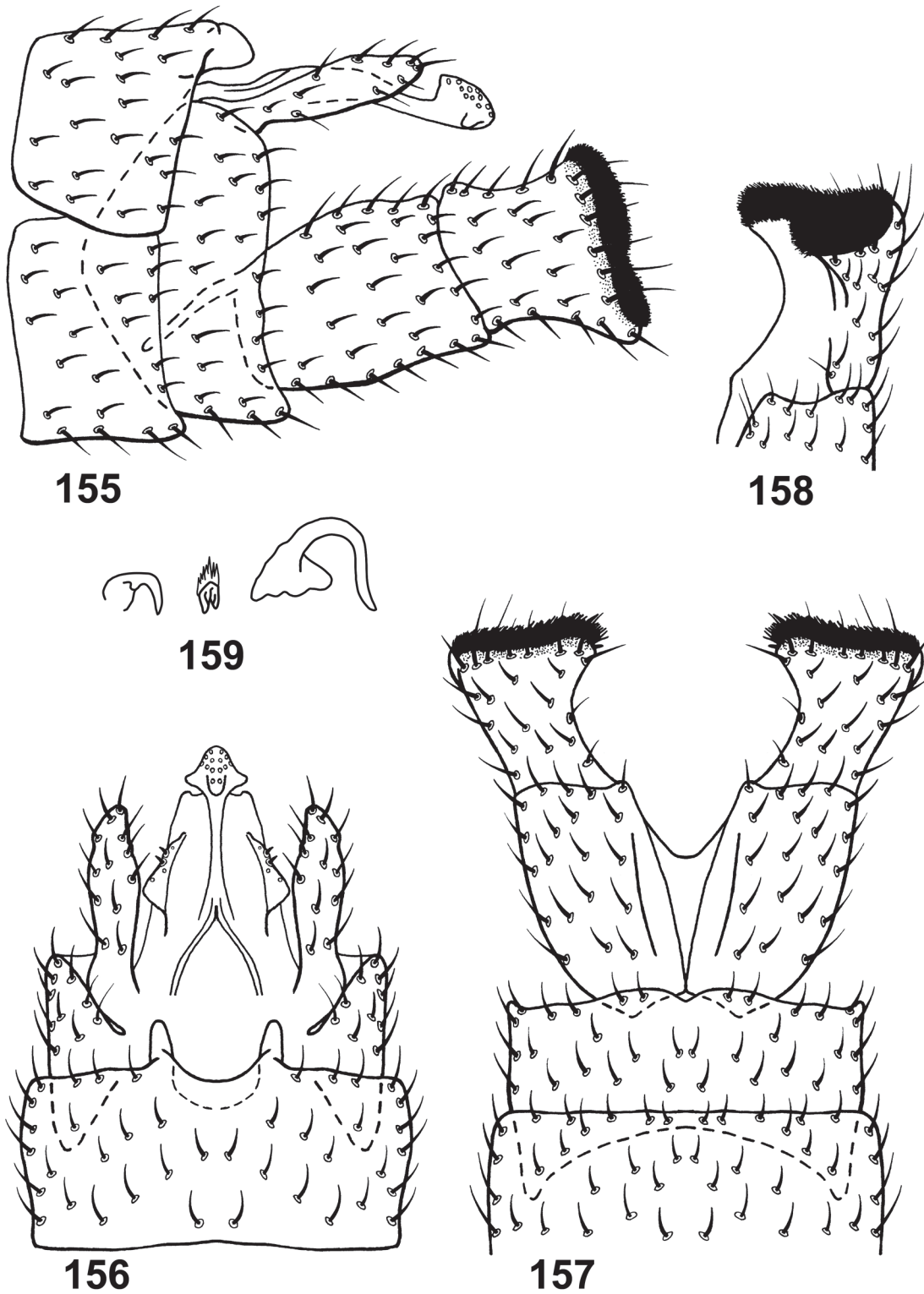


**FIGURES 148–152.** *Wormaldia boteroi*, new species. Male genitalia: 148, left lateral; 149, dorsal; 150, ventral; 151, apical segment of left inferior appendage, dorsomesal; 152, phallic sclerites.

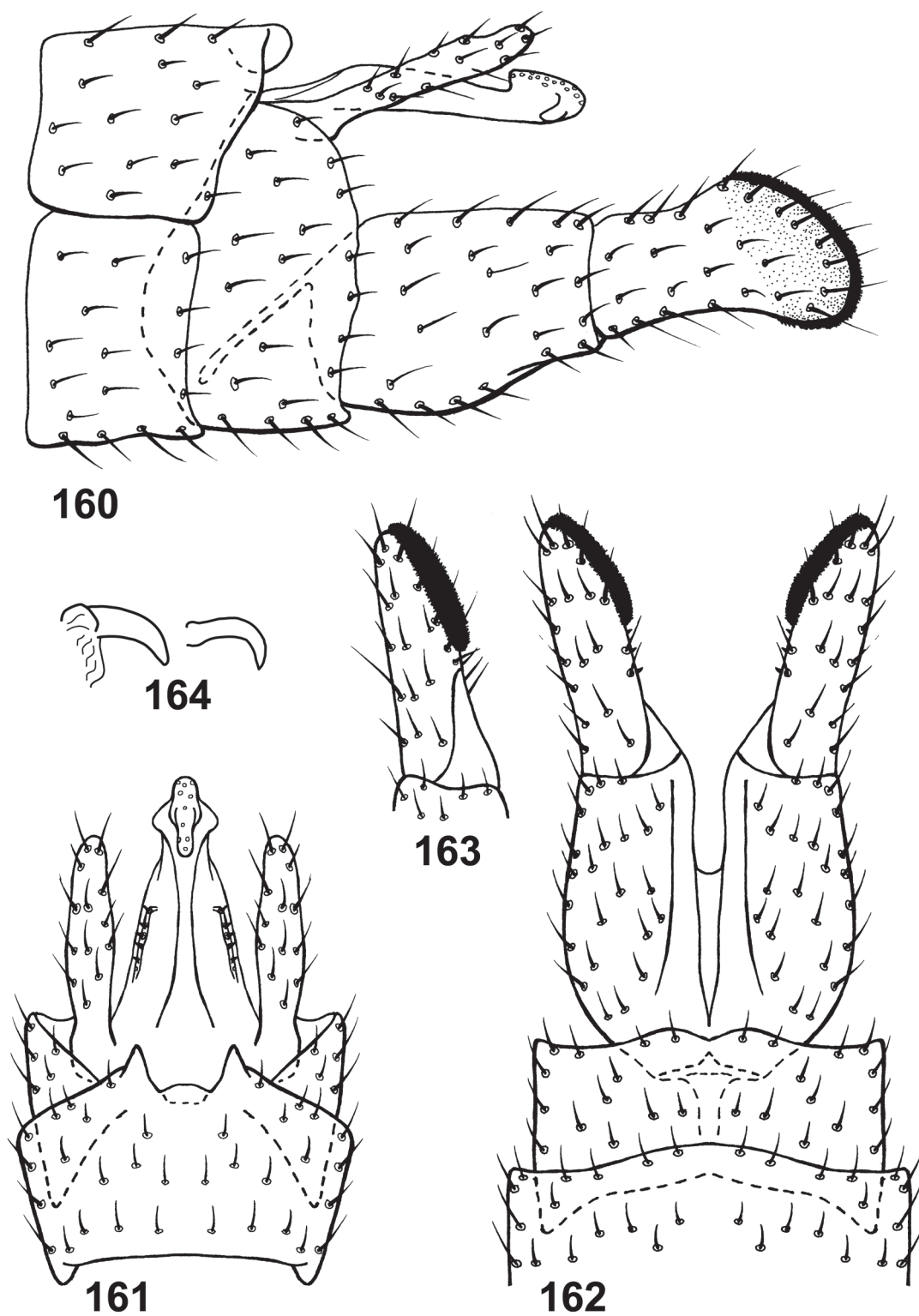


**FIGURES 153–154.** *Wormaldia boteroi*, new species. Wings: 153, right forewing, dorsal; 154, right hind wing, dorsal.

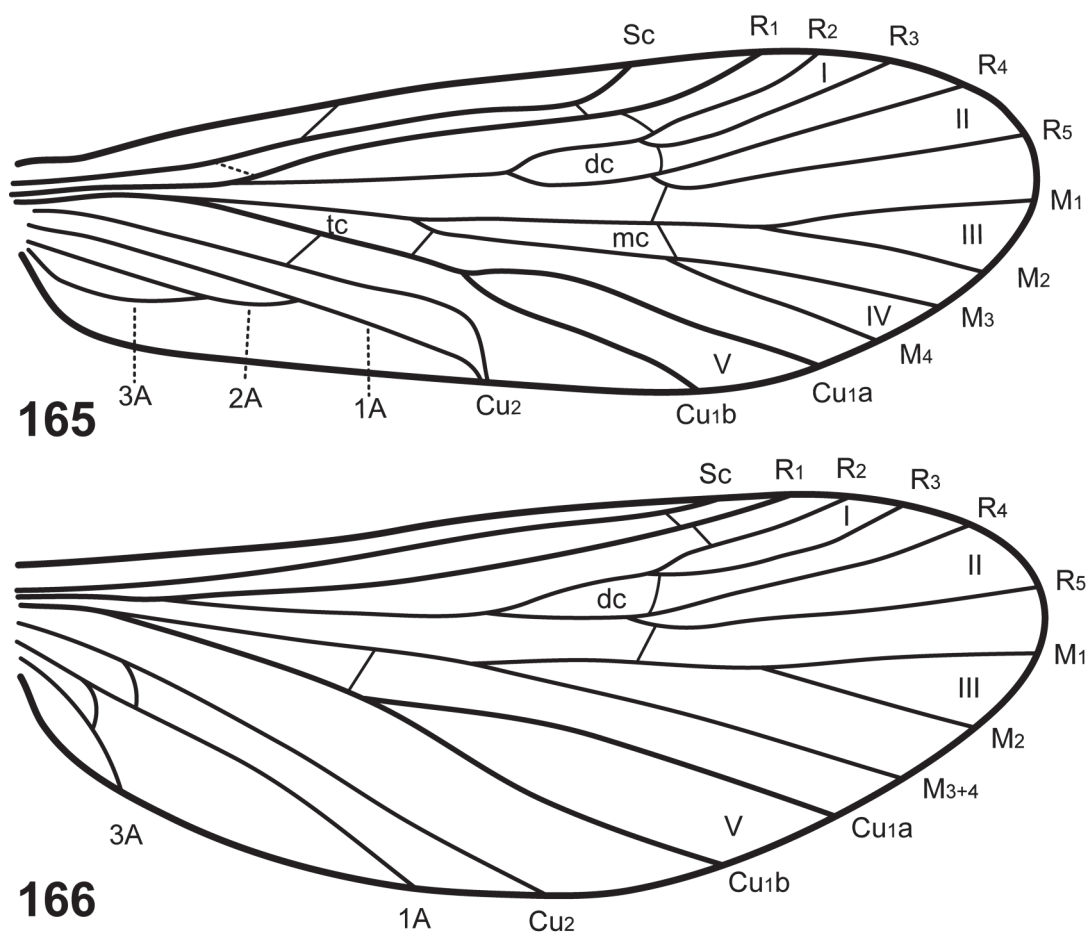




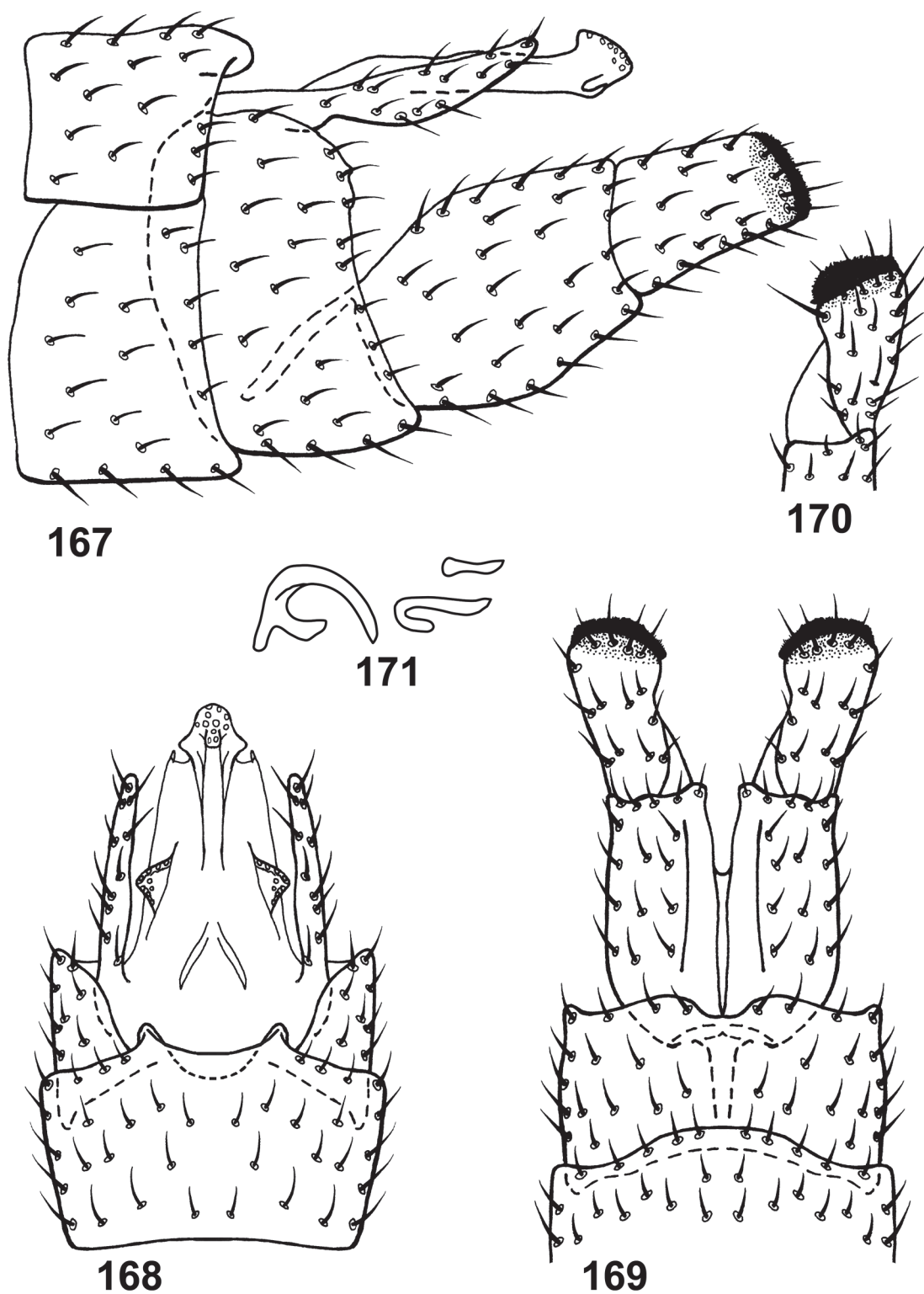
**FIGURES 155–159.** *Wormaldia eberhardi*, new species. Male genitalia: 155, left lateral; 156, dorsal; 157, ventral; 158, apical segment of left inferior appendage, dorsomesal; 159, phallic sclerites.



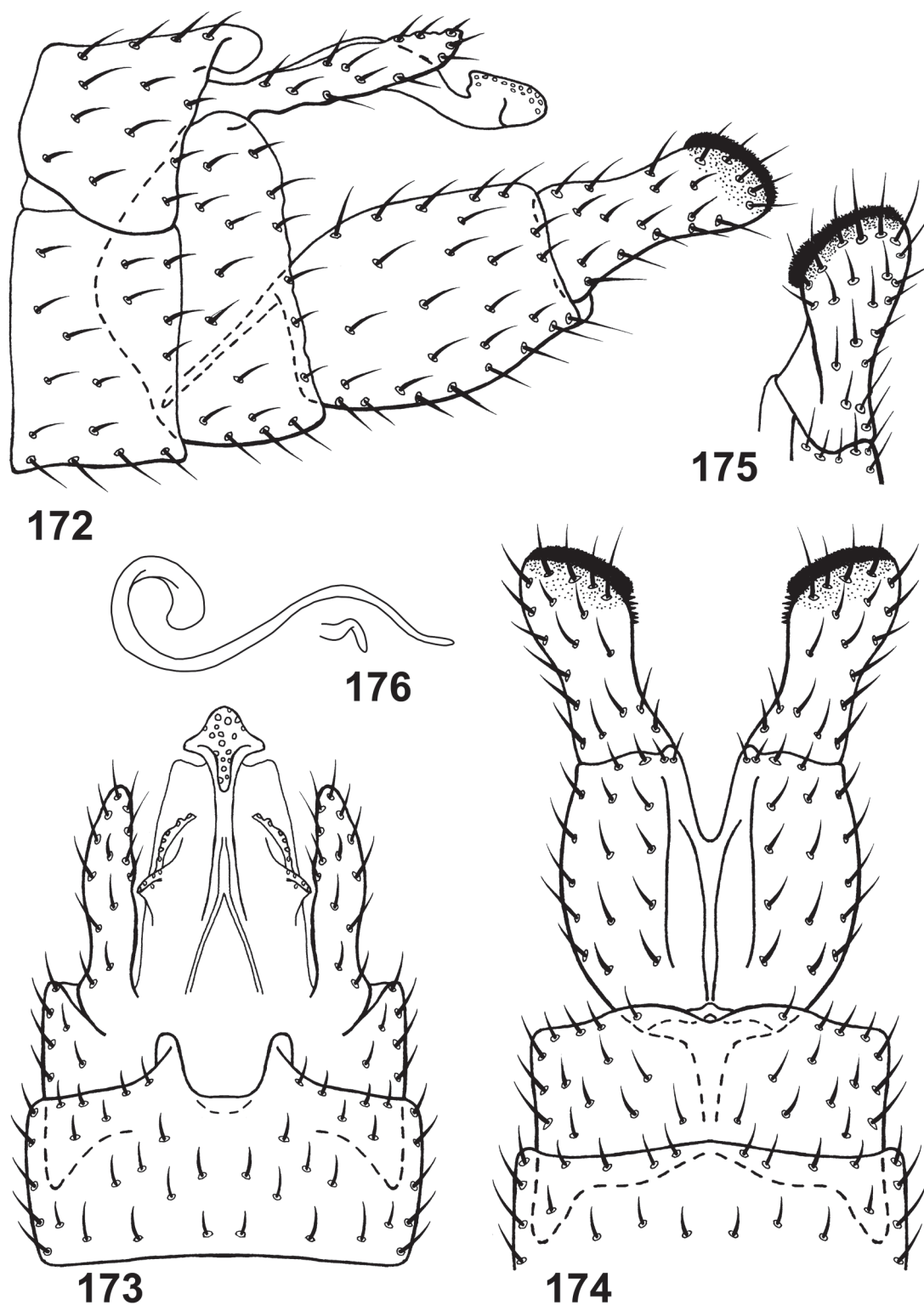
**FIGURES 160–164.** *Wormaldia hedamafera*, new species. Male genitalia: 160, left lateral; 161, dorsal; 162, ventral; 163, apical segment of right inferior appendage, dorsal; 164, phallic sclerites.



**FIGURES 165–166.** *Wormaldia hedamafera*, new species. Wings: 165, right forewing, dorsal; 166, right hind wing, dorsal.

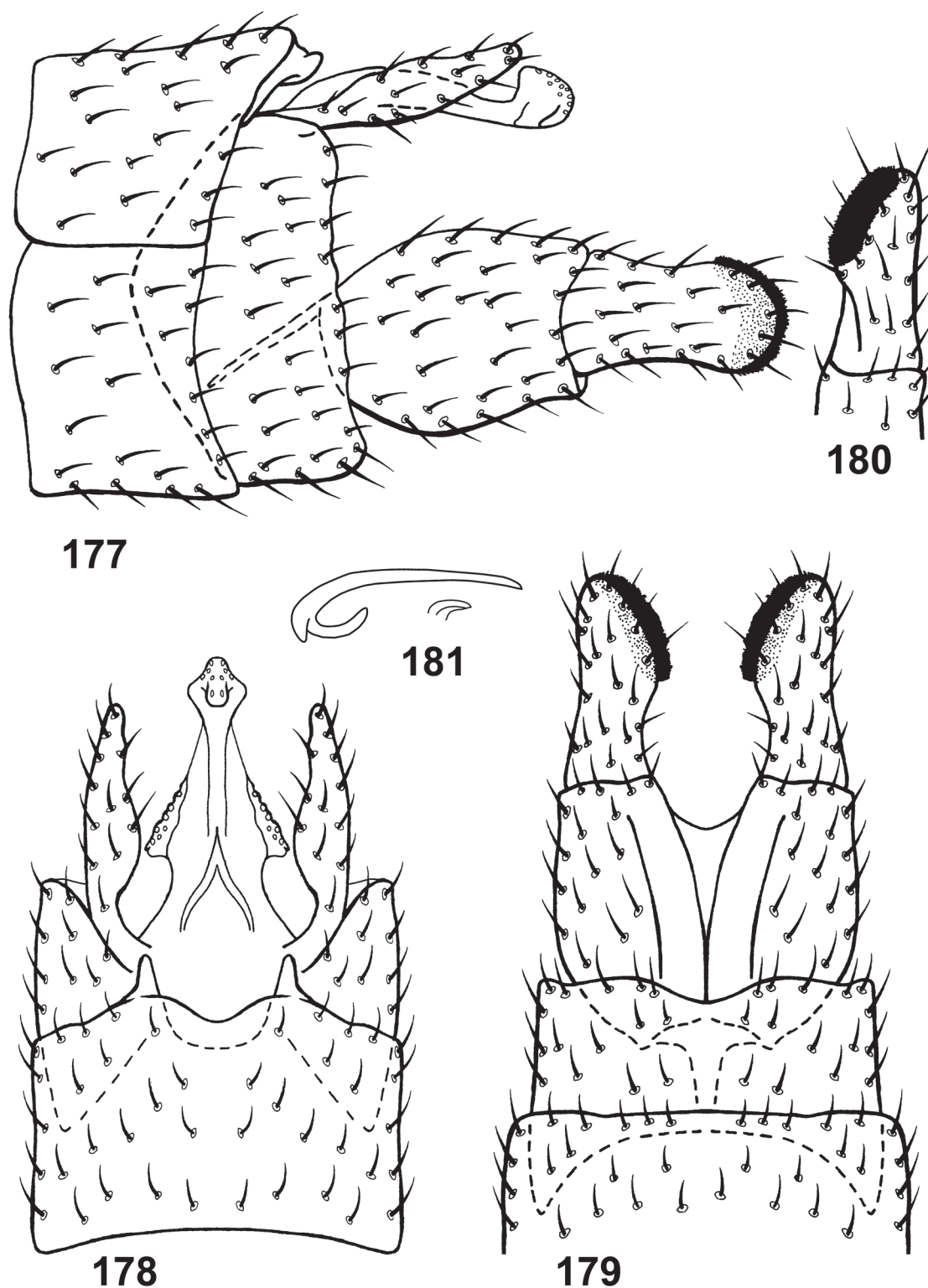


**FIGURES 167–171.** *Wormaldia bolivari*, new species. Male genitalia: 167, left lateral; 168, dorsal; 169, ventral; 170, apical segment of left inferior appendage, dorsal; 171, phallic sclerites.

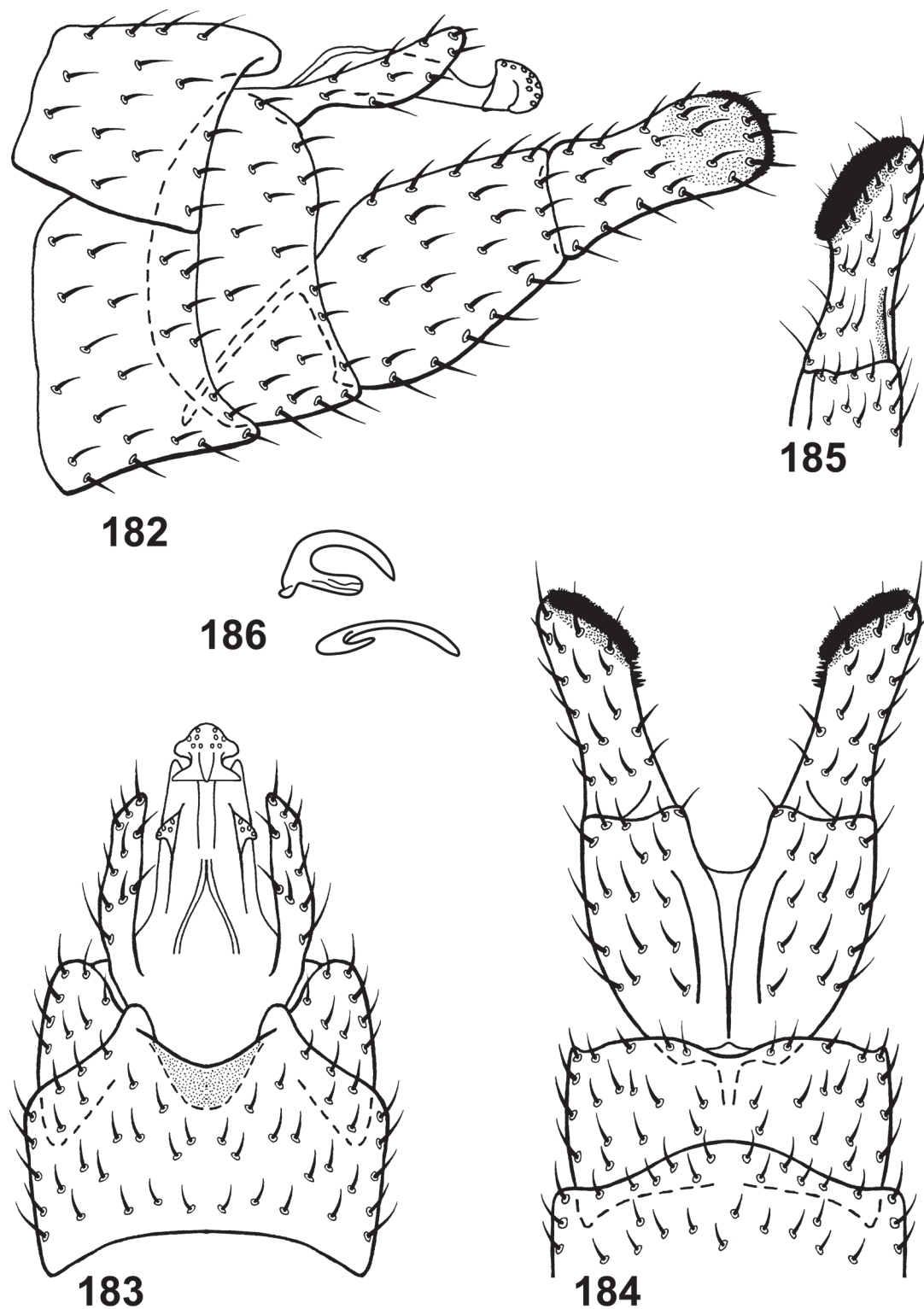


**FIGURES 172–176.** *Wormaldia barbai*, new species. Male genitalia: 172, left lateral; 173, dorsal; 174, ventral; 175, apical segment of left inferior appendage, dorsal; 176, phallic sclerites.

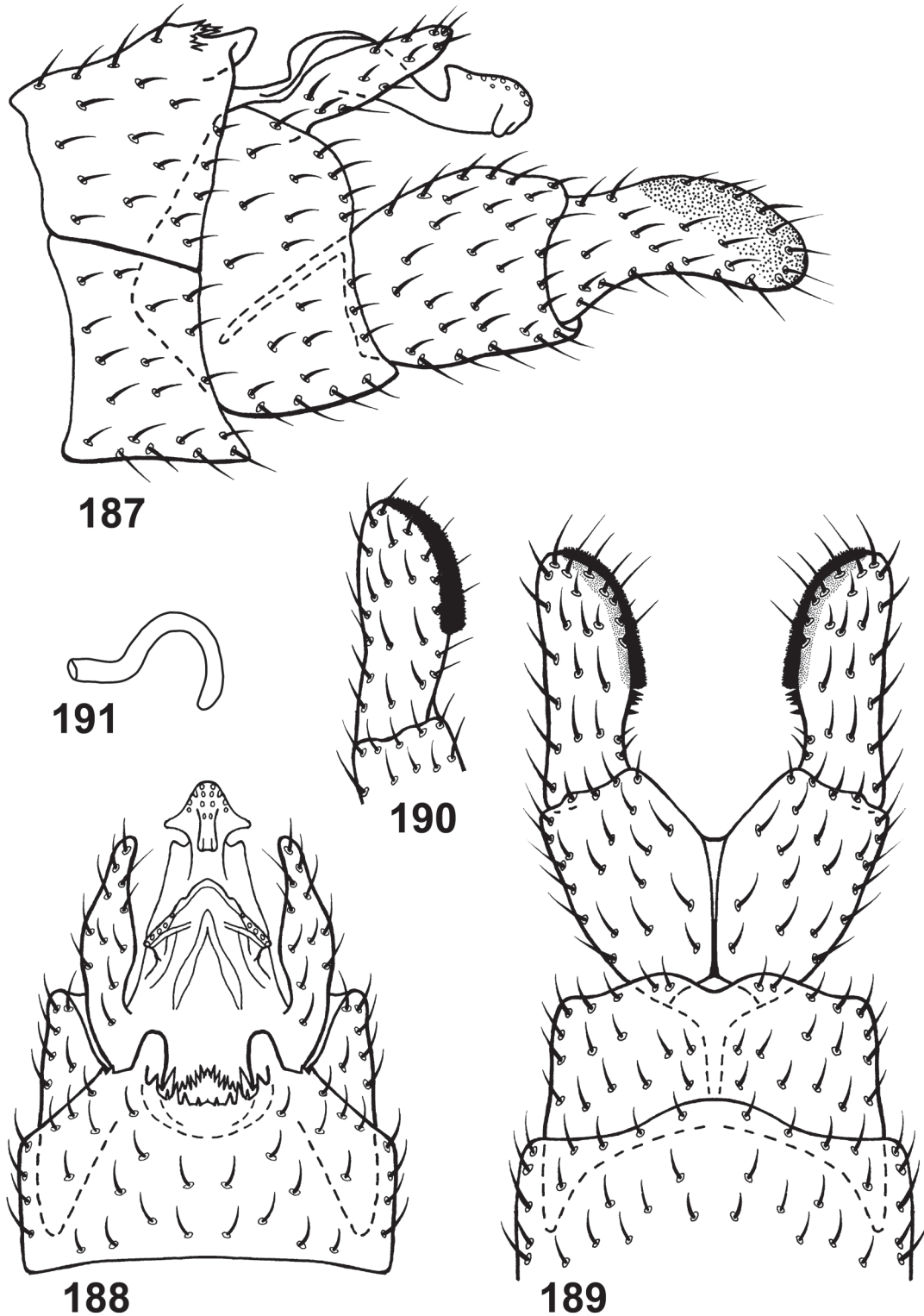




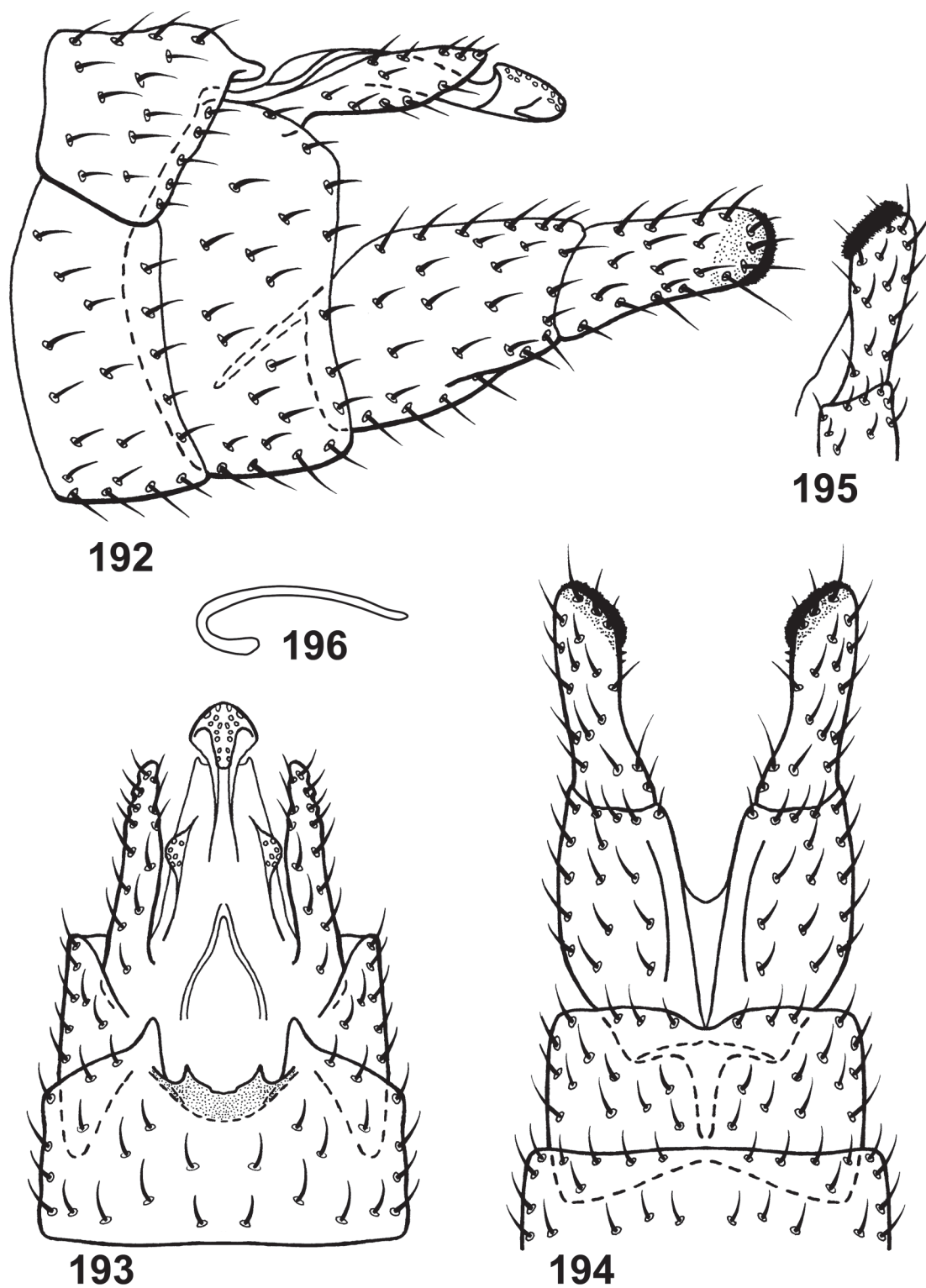
**FIGURES 177–181.** *Wormaldia savoriorum*, new species. Male genitalia: 177, left lateral; 178, dorsal; 179, ventral; 180, apical segment of left inferior appendage, dorsal; 181, phallic sclerites.



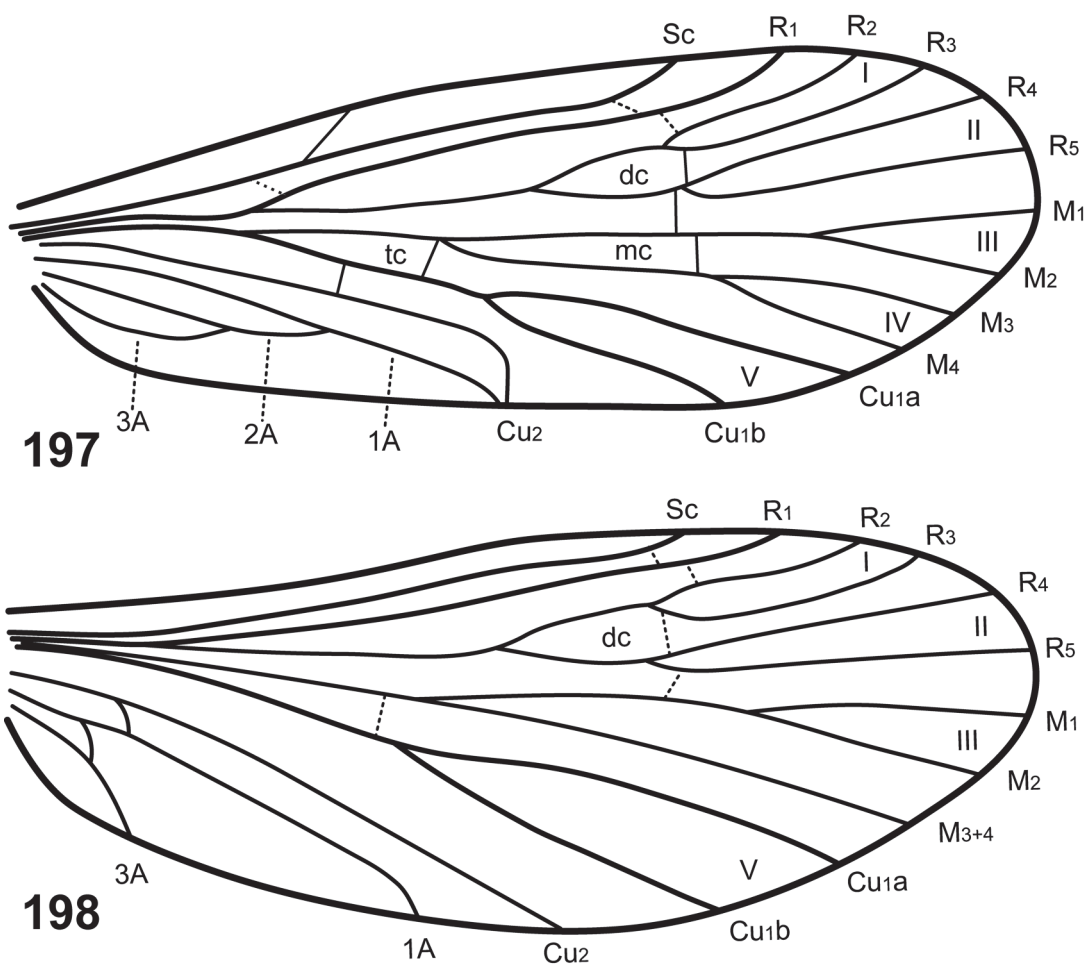
**FIGURES 182–186.** *Wormaldia zunigae*, new species. Male genitalia: 182, left lateral; 183, dorsal; 184, ventral; 185, apical segment of left inferior appendage, dorsal; 186, phallic sclerites.



**FIGURES 187–191.** *Wormaldia lauglo*, new species. Male genitalia: 187, left lateral; 188, dorsal; 189, ventral; 190, apical segment of right inferior appendage, dorsal; 191, phallic sclerite, left lateral.

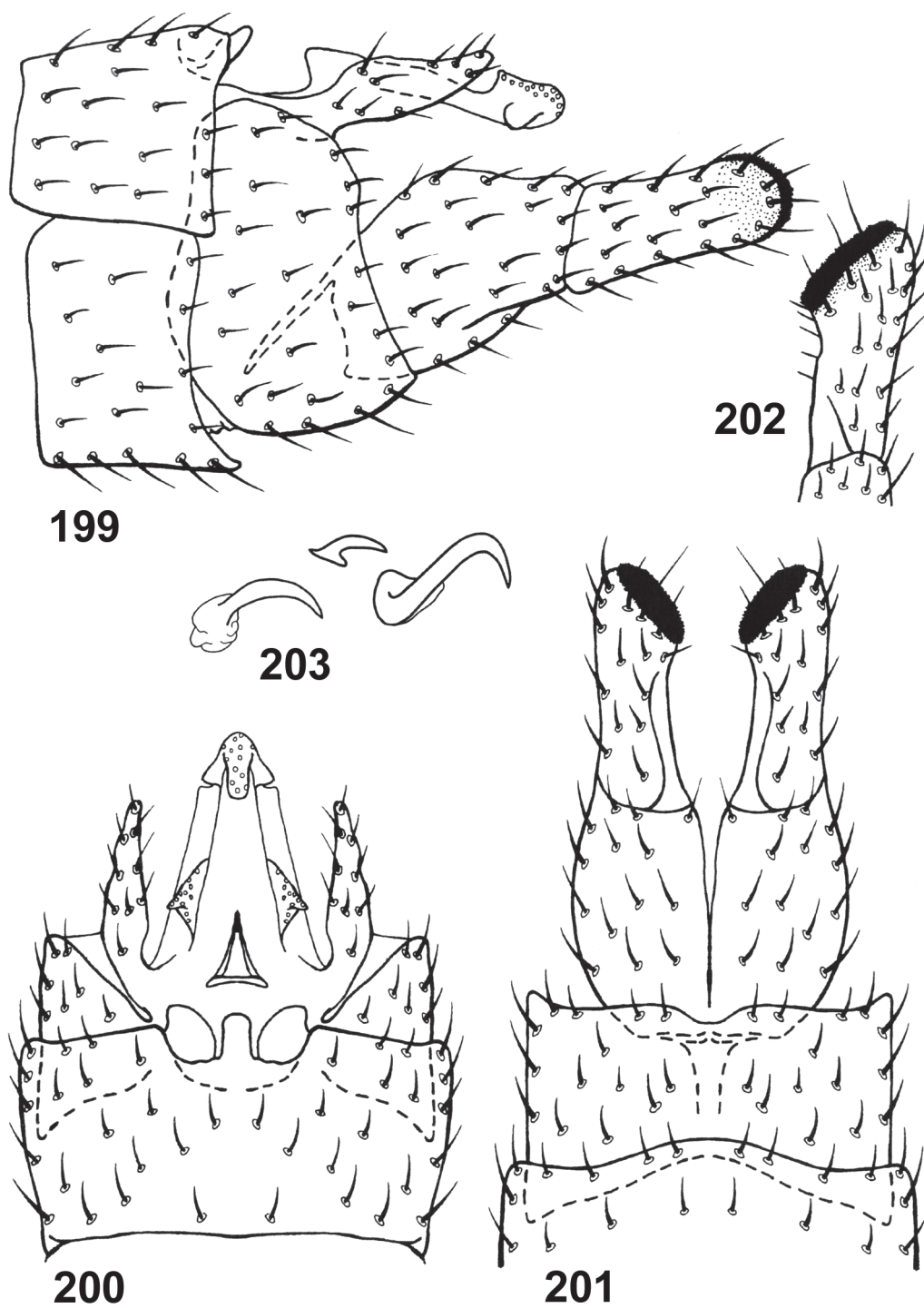


**FIGURES 192–196.** *Wormaldia menchuae*, new species. Male genitalia: 192, left lateral; 193, dorsal; 194, ventral; 195, apical segment of left inferior appendage, dorsal; 196, phallic sclerite, left lateral.

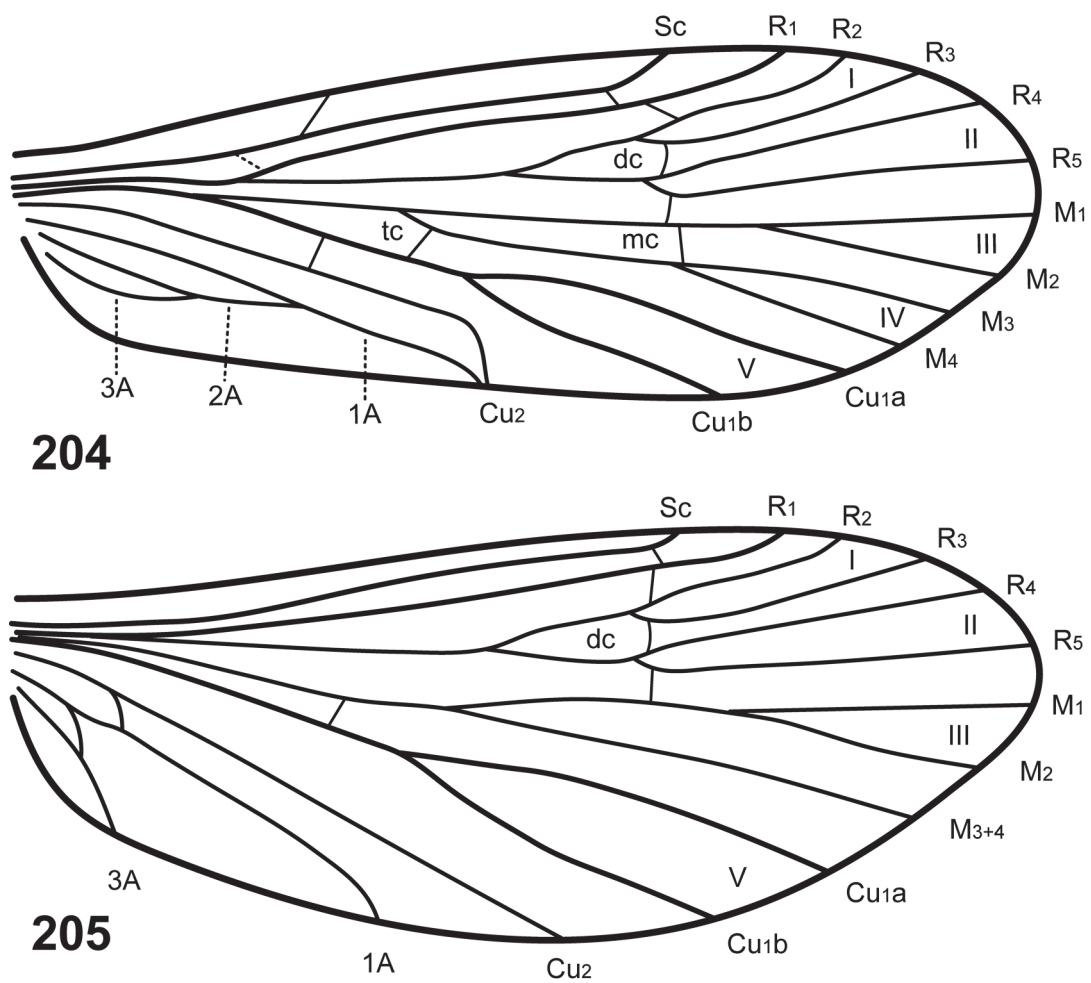


**FIGURES 197–198.** *Wormaldia menchucae*, new species. Wings: 197, right forewing, dorsal; 198, right hind wing, dorsal.

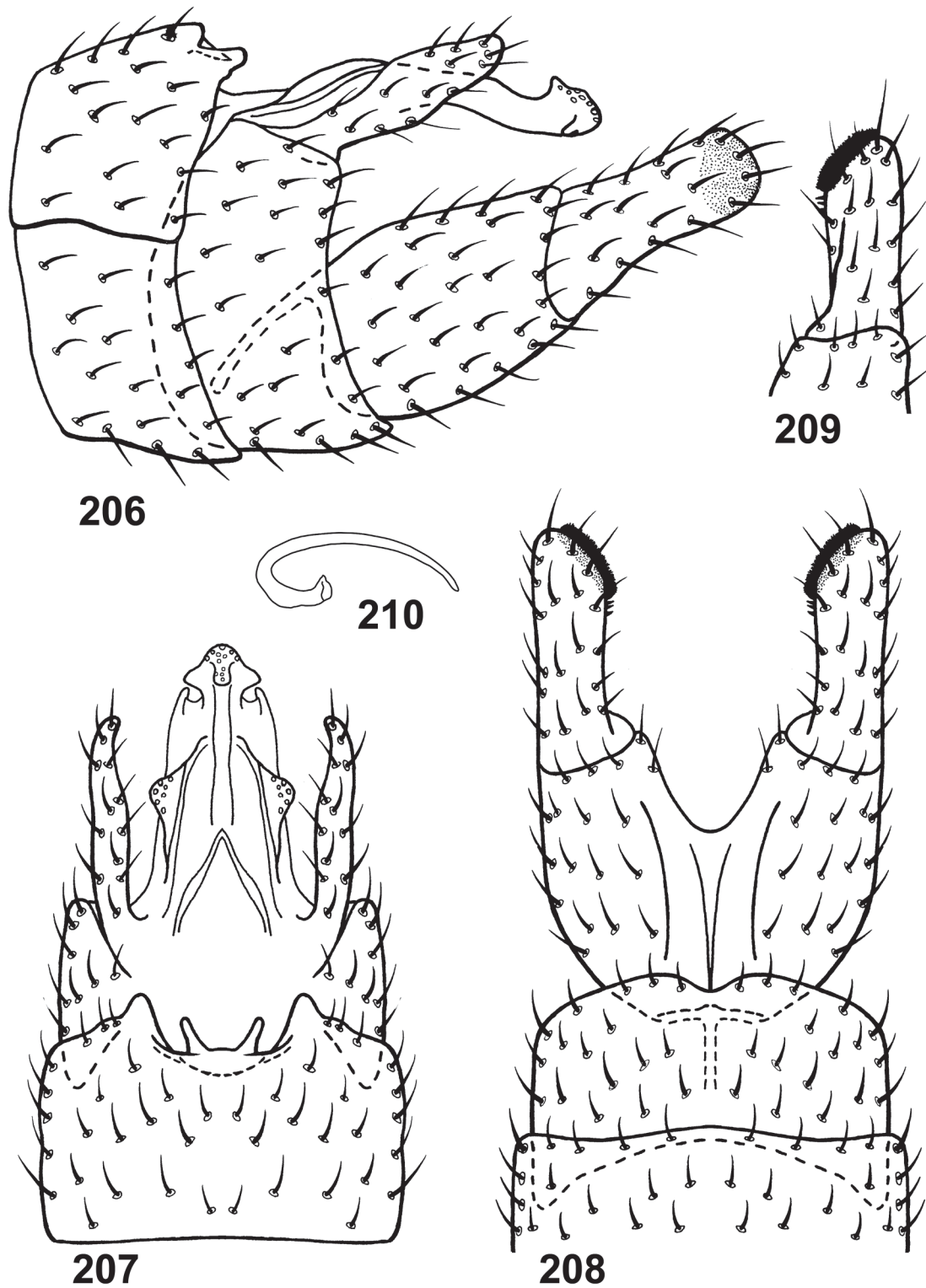




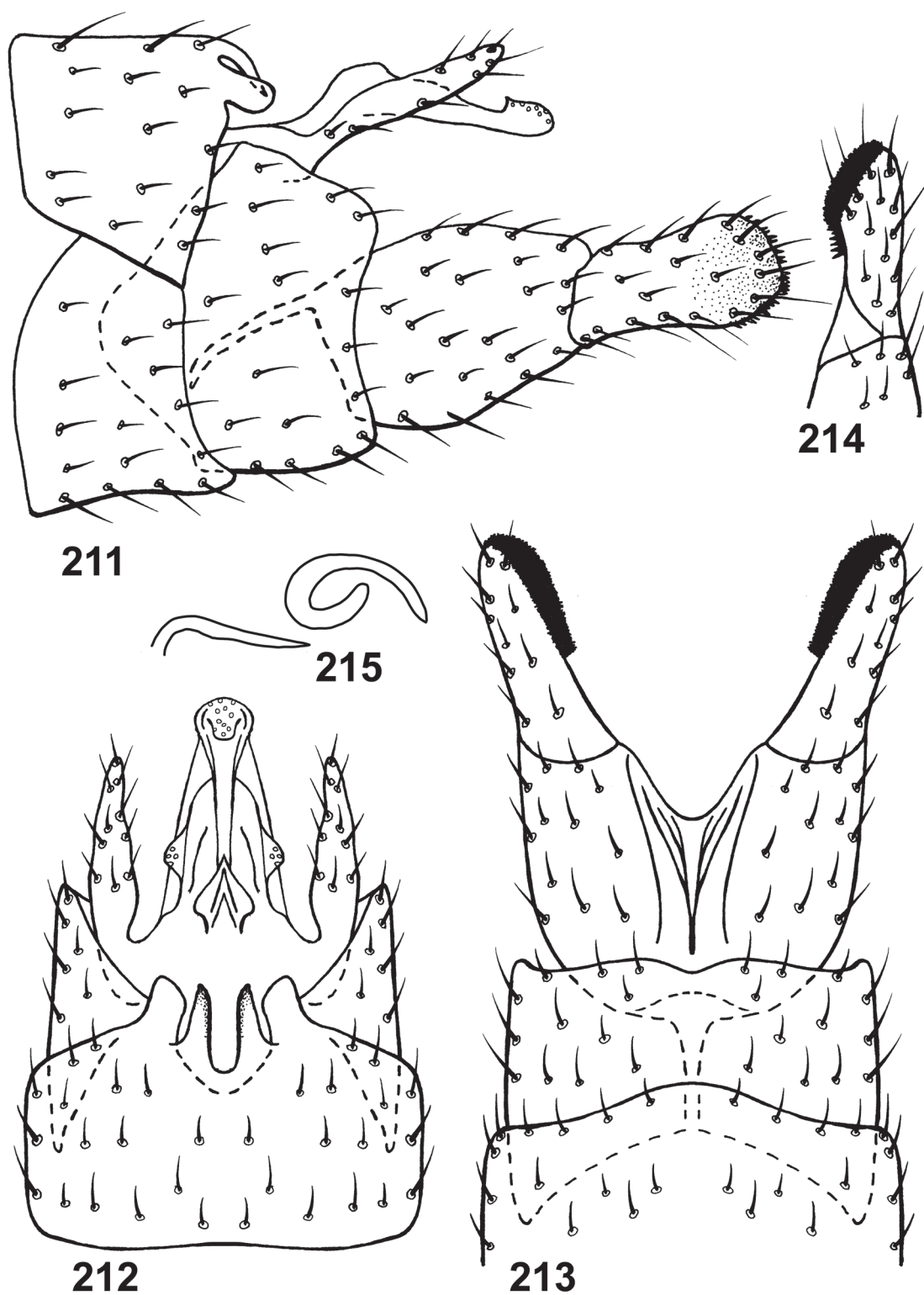
**FIGURES 199–203.** *Wormaldia juarox*, new species. Male genitalia: 199, left lateral; 200, dorsal; 201, ventral; 202, apical segment of left inferior appendage, dorsal; 203, phallic sclerites.



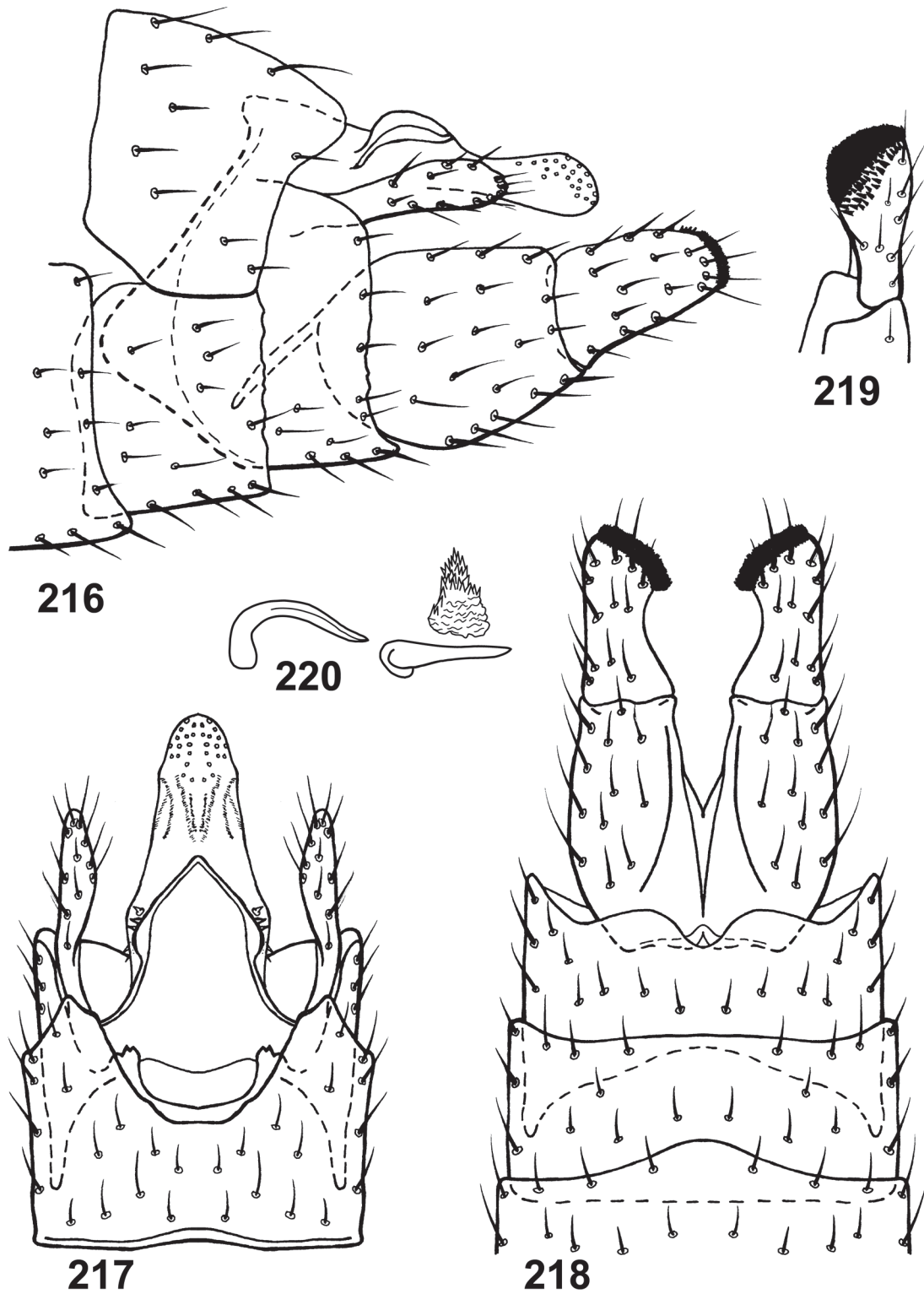
**FIGURES 204–205.** *Wormaldia juarox*, new species. Wings: 204, right forewing, dorsal; 205, right hind wing, dorsal.



**FIGURES 206–210.** *Wormaldia calderonae*, new species. Male genitalia: 206, left lateral; 207, dorsal; 208, ventral; 209, apical segment of left inferior appendage, dorsal; 210, phallic sclerite, left lateral.

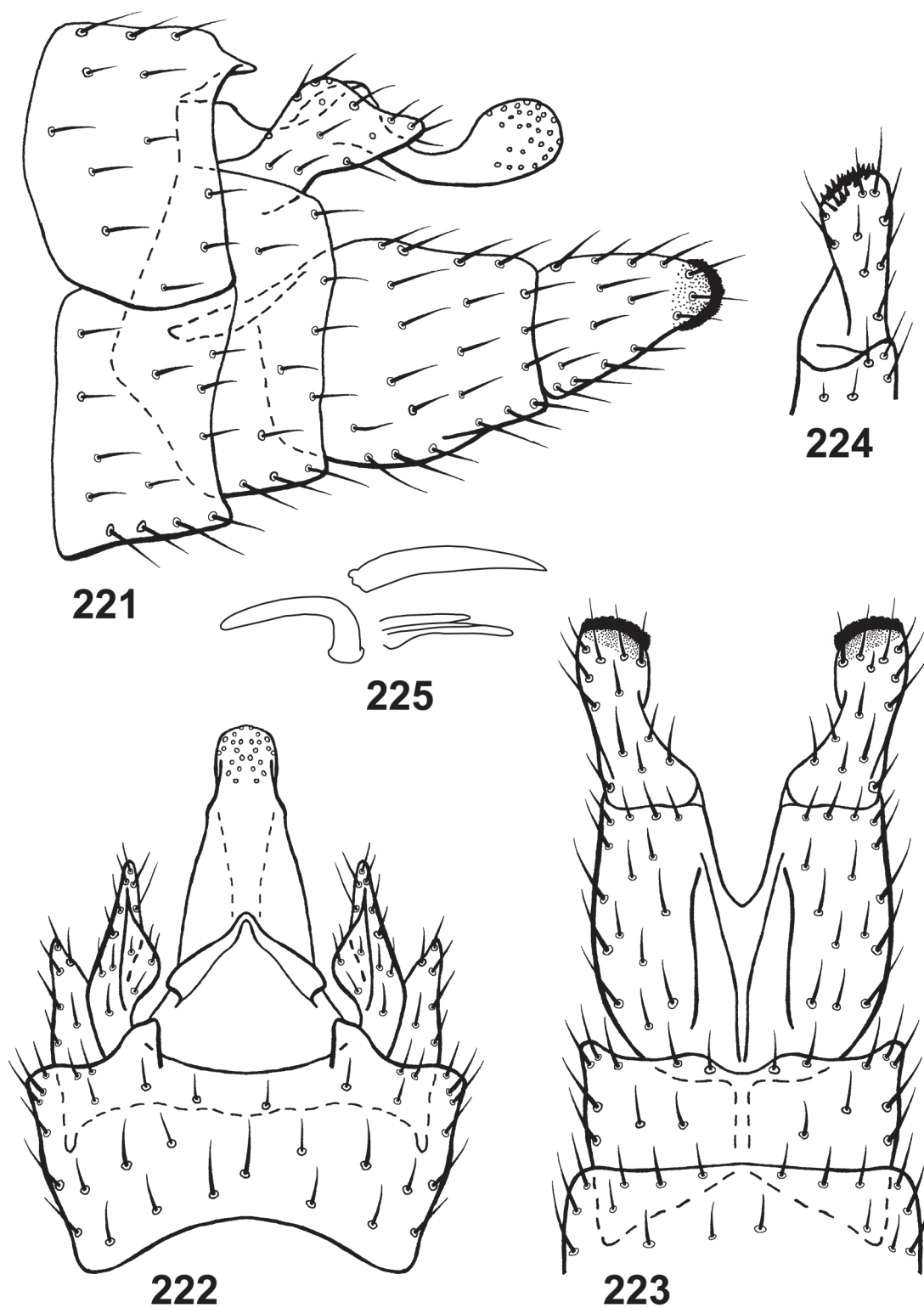


**FIGURES 211–215.** *Wormaldia trondi*, new species. Male genitalia: 211, left lateral; 212, dorsal; 213, ventral; 214, apical segment of left inferior appendage, dorsal; 215, phallic sclerites.

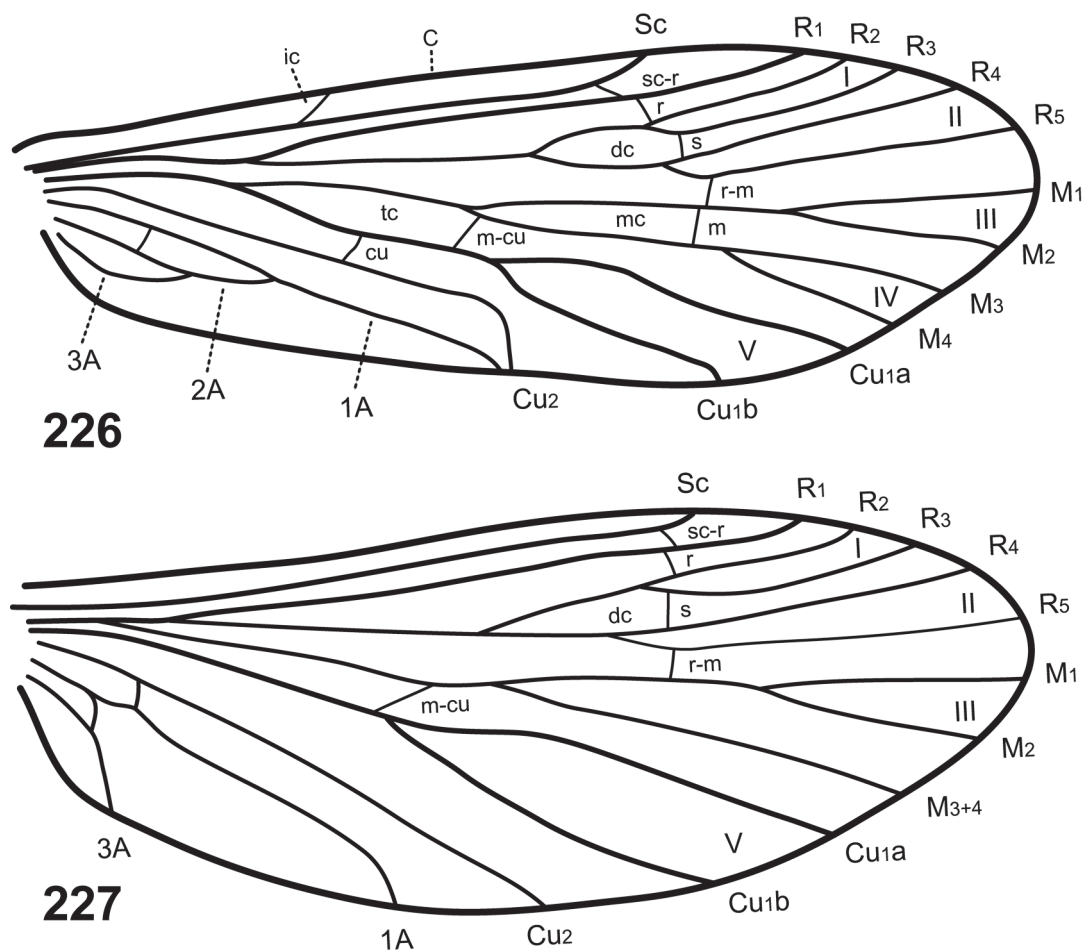


**FIGURES 216–220.** *Wormaldia tarasca* Bueno-Soria & Holzenthal. Male genitalia: 216, left lateral; 217, dorsal; 218, ventral; 219, apical segment of left inferior appendage, dorsal; 220, phallic sclerites.

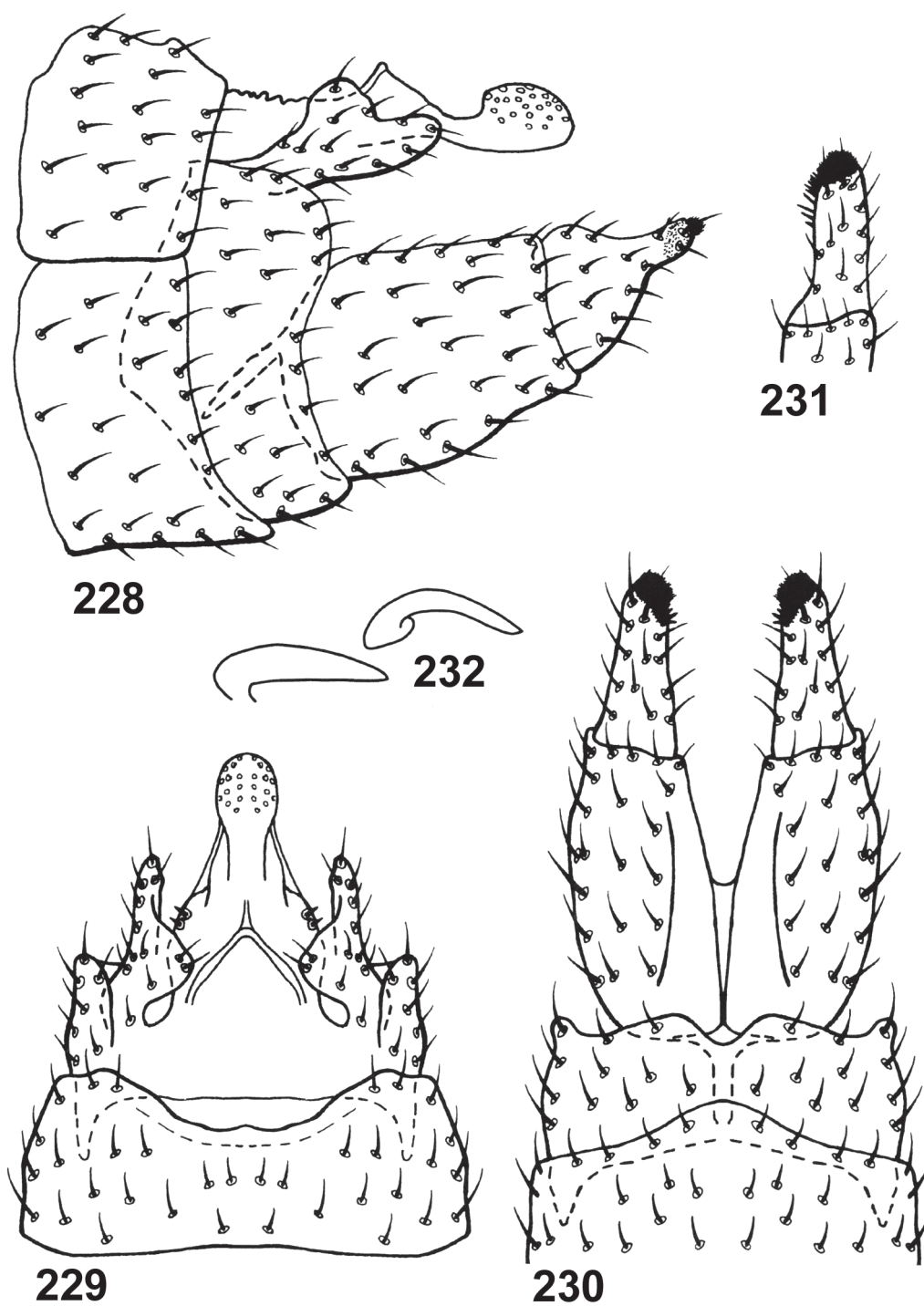




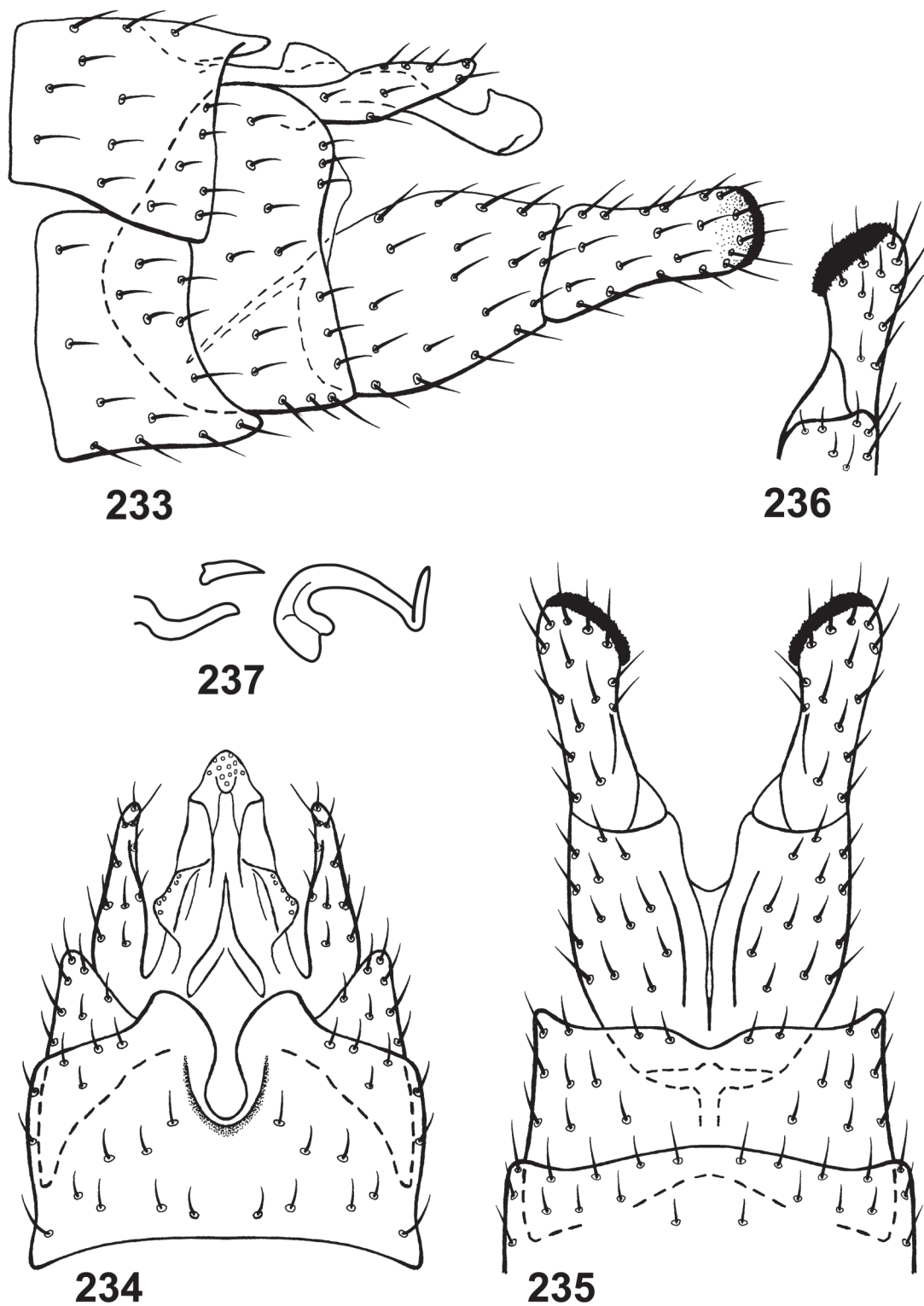
**FIGURES 221–225.** *Wormaldia arizonensis* (Ling). Male genitalia: 221, left lateral; 222, dorsal; 223, ventral; 224, apical segment of left inferior appendage, dorsal; 225, phallic sclerites.



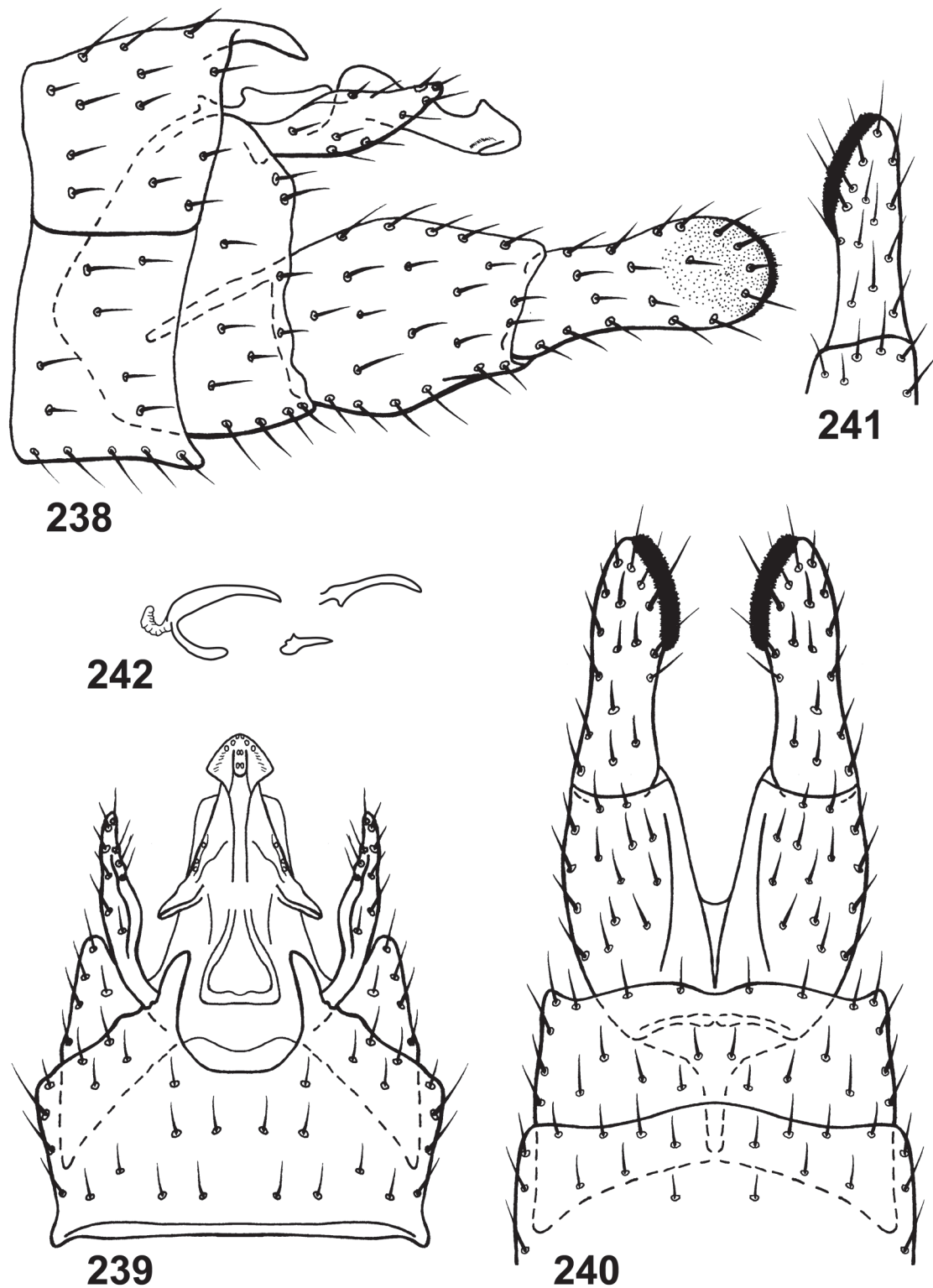
**FIGURES 226–227.** *Wormaldia arizonensis* (Ling). Wings: 226, right forewing, dorsal; 227, right hind wing, dorsal. Abbreviations: Veins: A = anal; C = costa; Cu = cubitus; M = medius; R = radius; Sc = subcosta. Crossveins: *cu* = cubital, *ic* = intercostal, *m* = medial, *m-cu* = medio-cubital, *r* = radial, *r-m* = radio-medial, *s* = sectoral, *sc-r* = subcostal-radial. Cells: *dc* = discoidal, *mc* = medial, *tc* = thyridial. Forks: I, II, III, IV, V.



**FIGURES 228–232.** *Wormaldia navarroae*, new species. Male genitalia: 228, left lateral; 229, dorsal; 230, ventral; 231, apical segment of left inferior appendage, dorsal; 232, phallic sclerites.

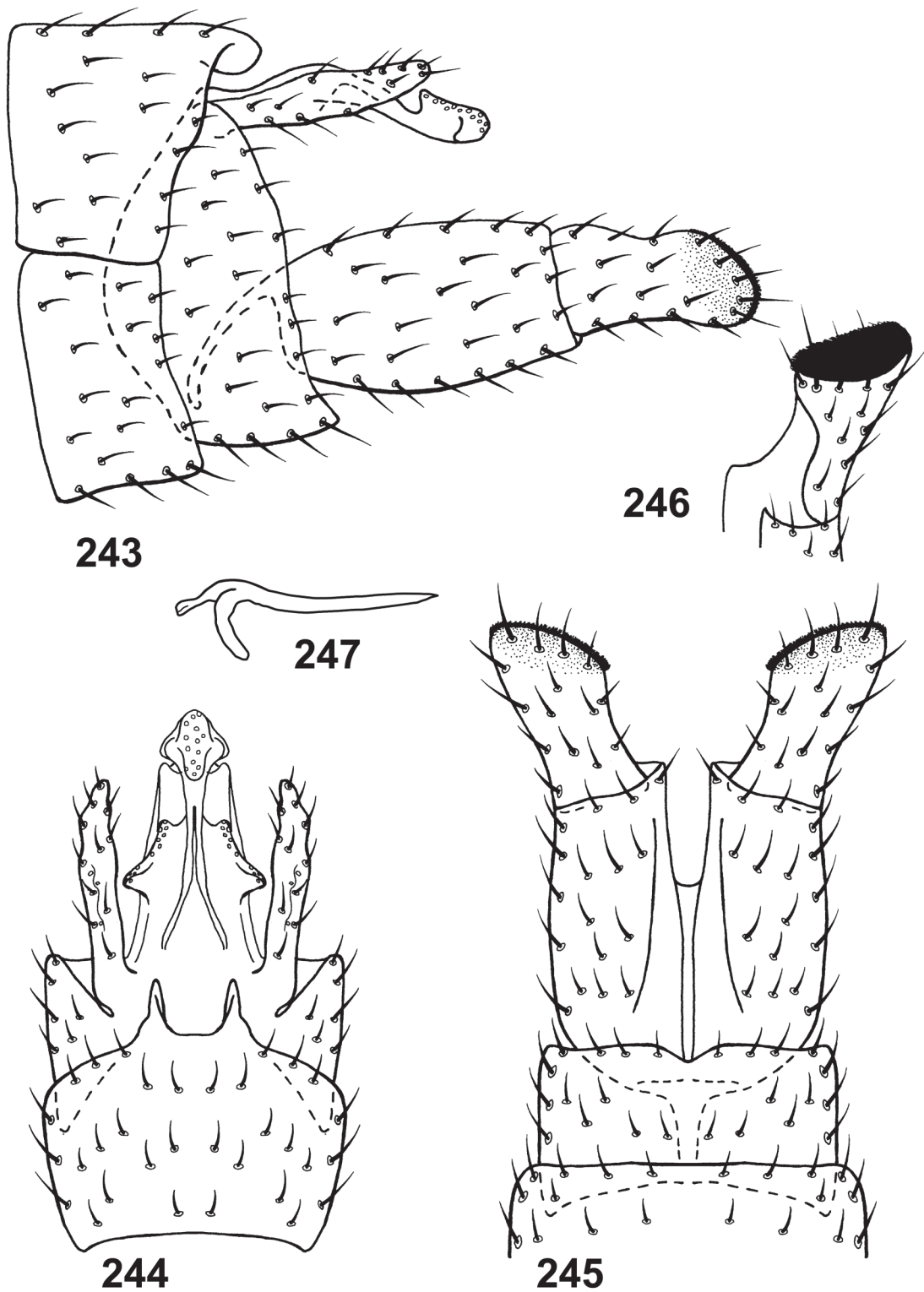


**FIGURES 233–237.** *Wormaldia monsonorum*, new species. Male genitalia: 233, left lateral; 234, dorsal; 235, ventral; 236, apical segment of left inferior appendage, dorsal; 237, phallic sclerites.

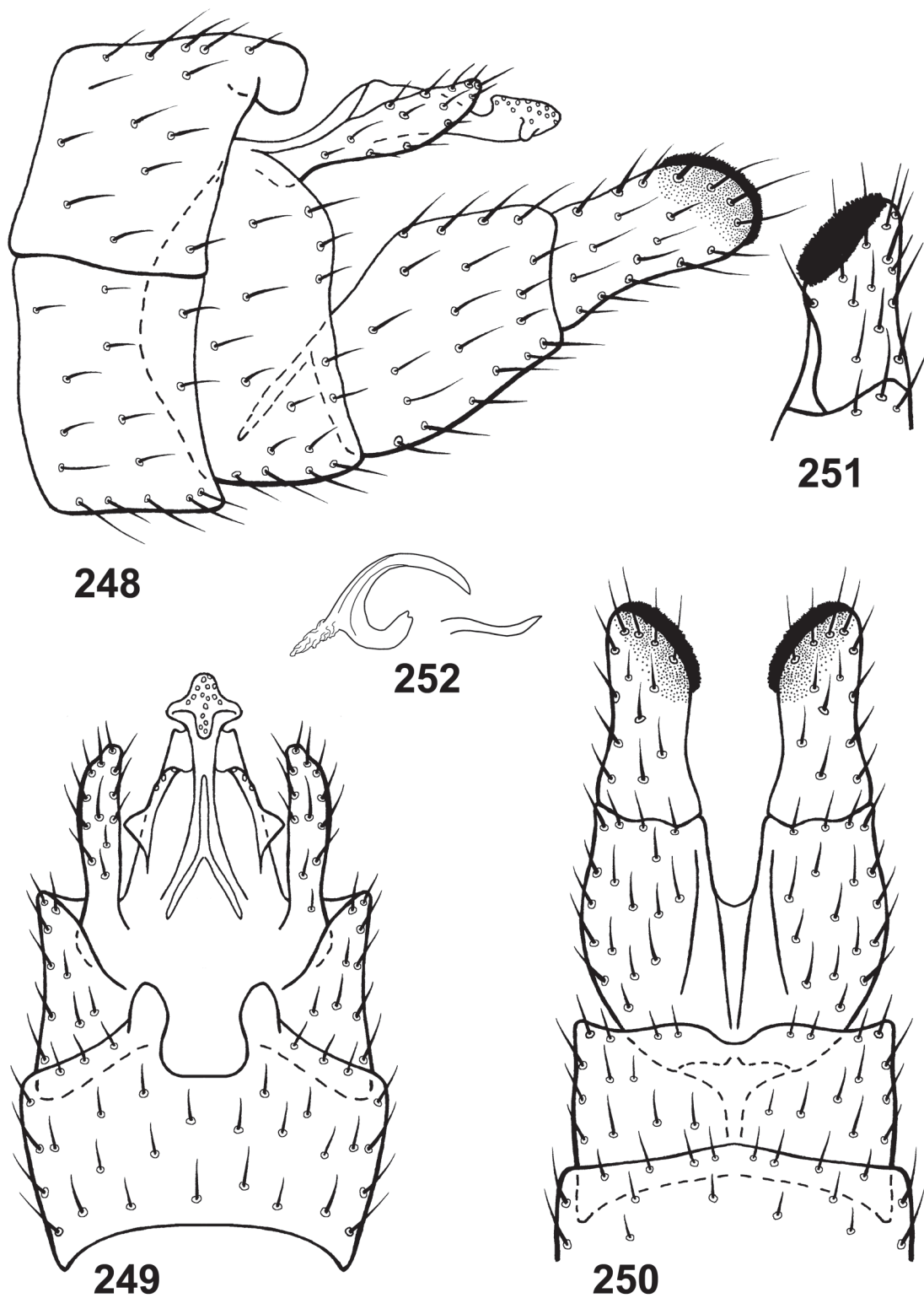


**FIGURES 238–242.** *Wormaldia cornuta* Bueno-Soria & Holzenthal. Male genitalia: 238, left lateral; 239, dorsal; 240, ventral; 241, apical segment of left inferior appendage, dorsal; 242, phallic sclerites.

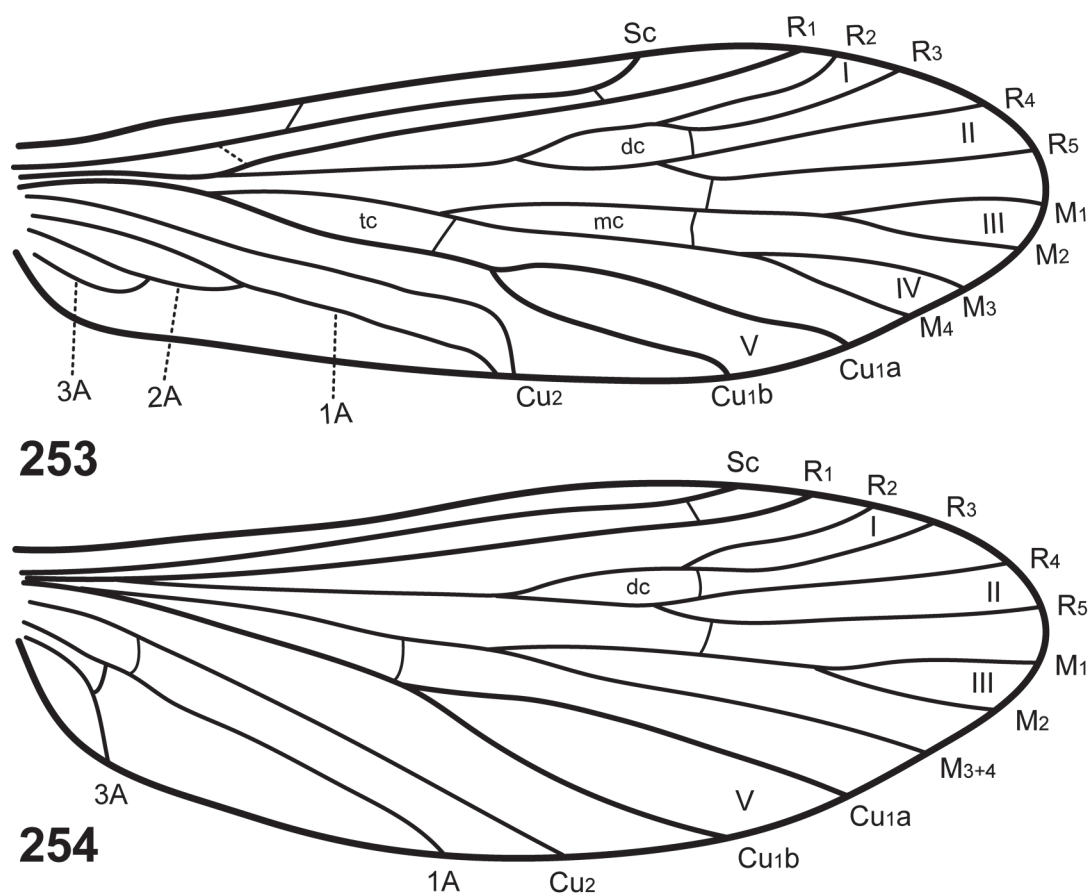




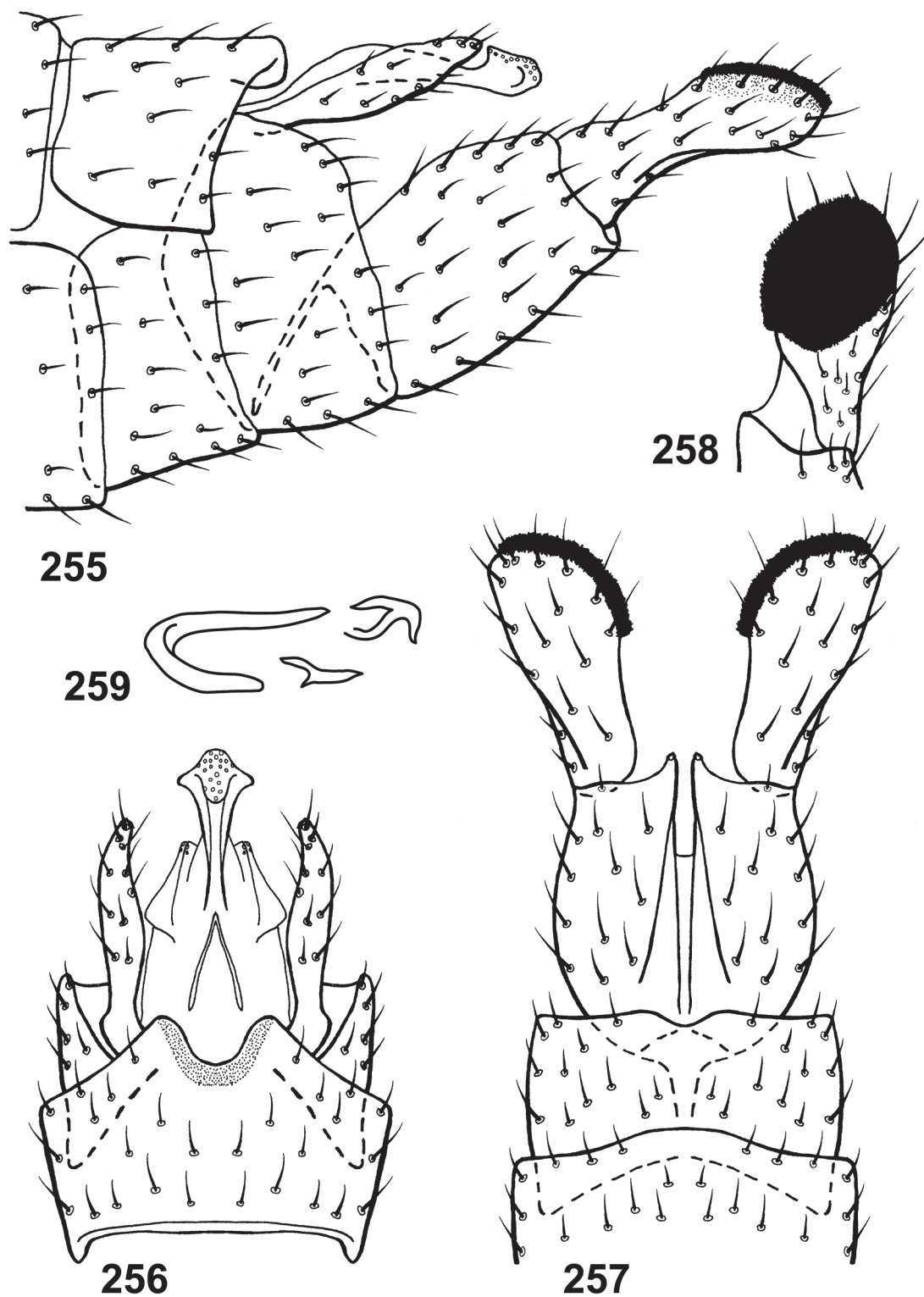
**FIGURES 243–247.** *Wormaldia buenorum*, new species. Male genitalia: 243, left lateral; 244, dorsal; 245, ventral; 246, apical segment of left inferior appendage, dorsal; 247, phallic sclerite, left lateral.



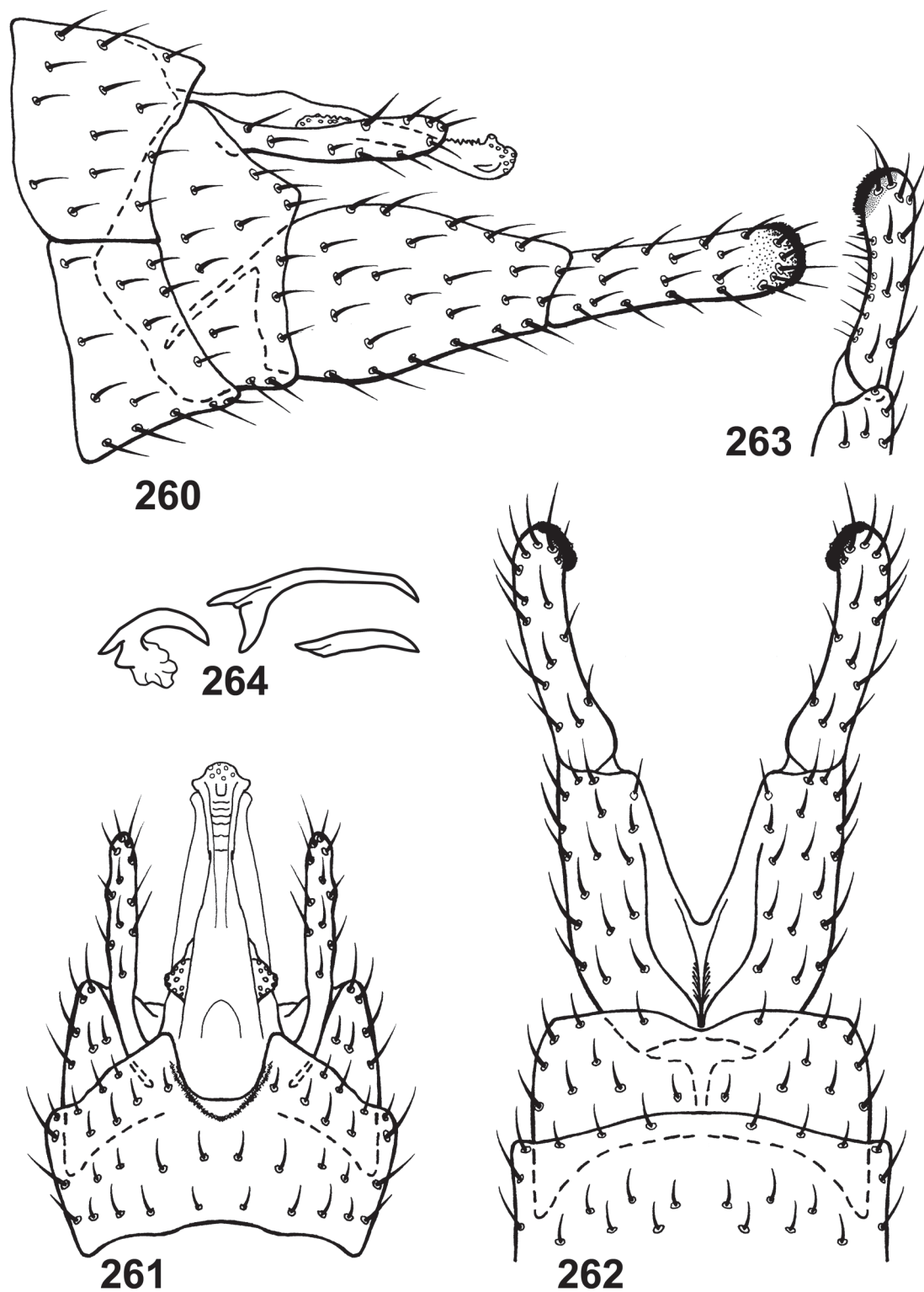
**FIGURES 248–252.** *Wormaldia planae* Ross & King. Male genitalia: 248, left lateral; 249, dorsal; 250, ventral; 251, apical segment of left inferior appendage, dorsal; 252, phallic sclerites.



FIGURES 253–254. *Wormaldia plana* Ross & King. Wings: 253, right forewing, dorsal; 254, right hind wing, dorsal.

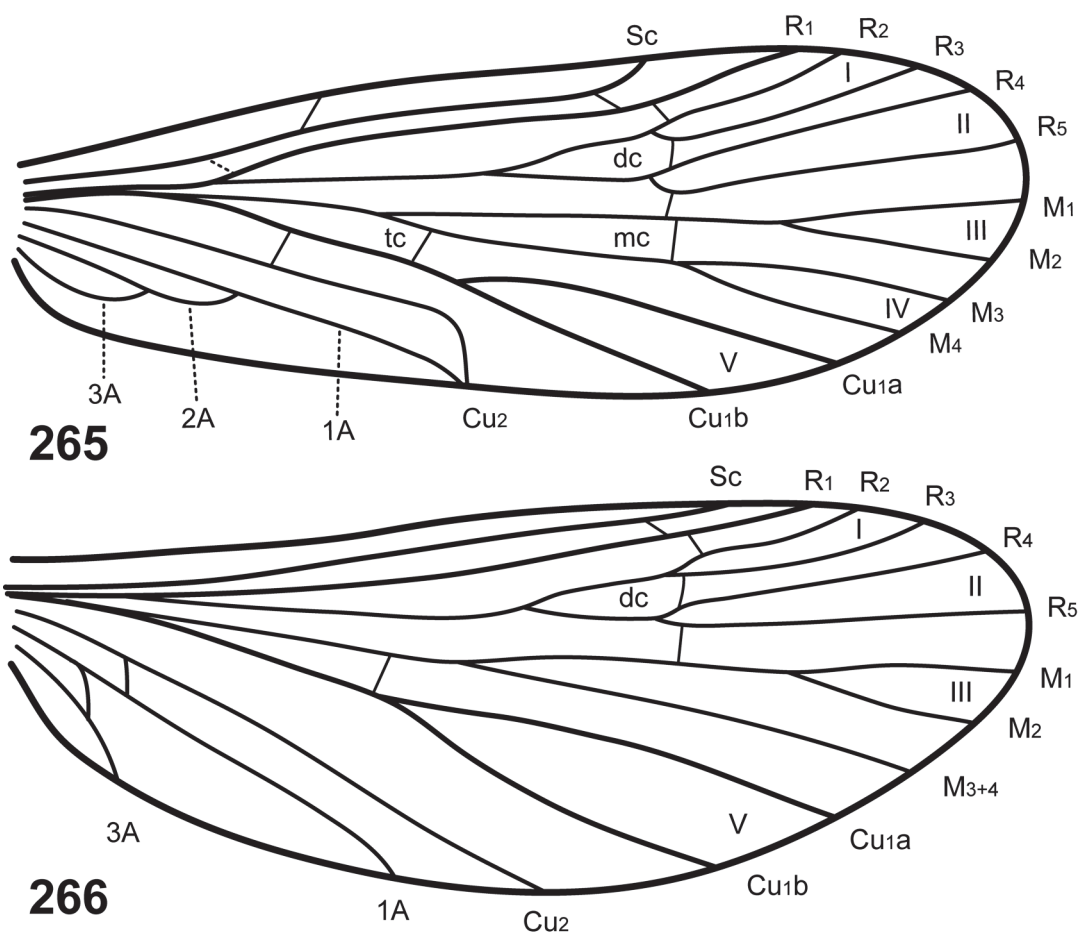


**FIGURES 255–259.** *Wormaldia anhelitus*, new species. Male genitalia: 255, left lateral; 256, dorsal; 257, ventral; 258, apical segment of left inferior appendage, dorsal; 259, phallic sclerites.

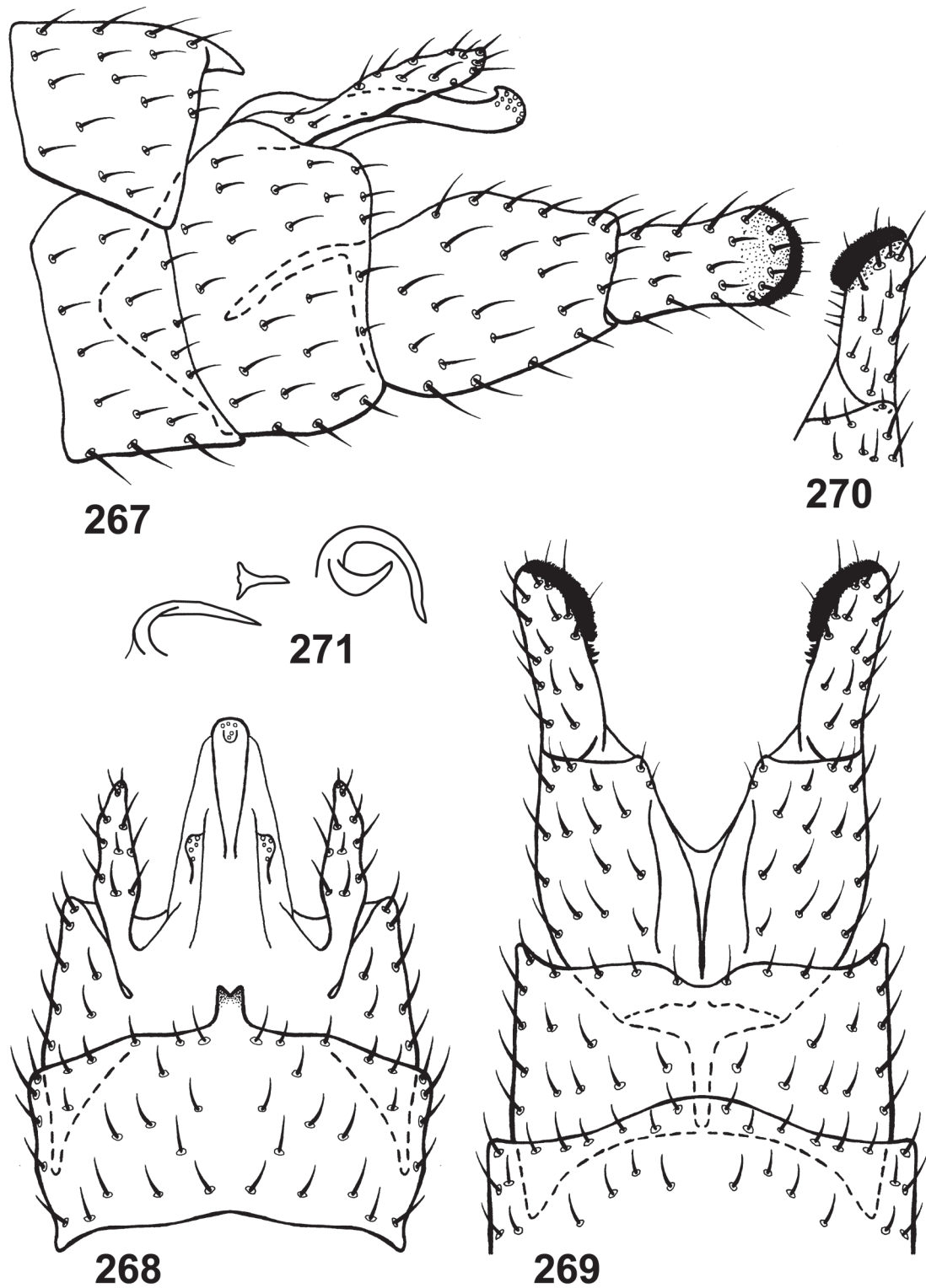


**FIGURES 260–264.** *Wormaldia tocajoma*, new species. Male genitalia: 260, left lateral; 261, dorsal; 262, ventral; 263, apical segment of left inferior appendage, dorsal; 264, phallic sclerites.

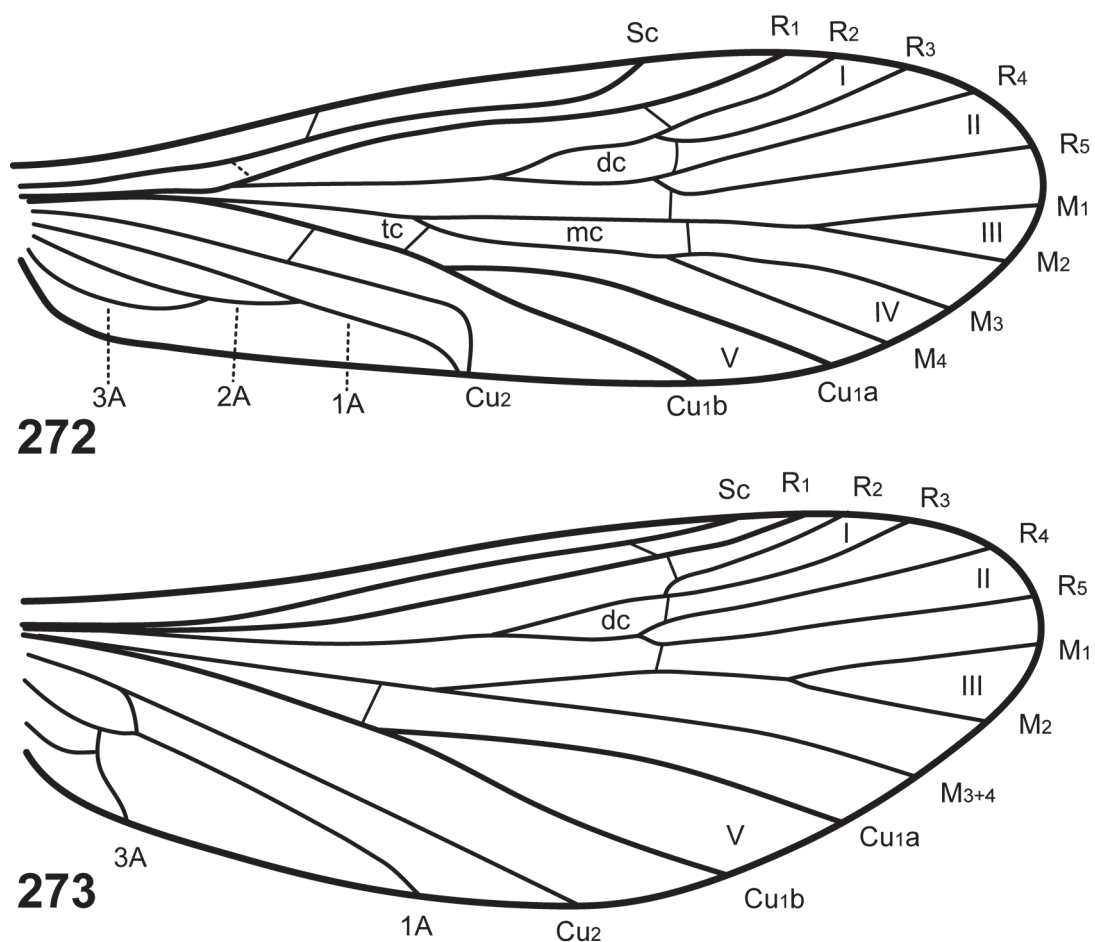




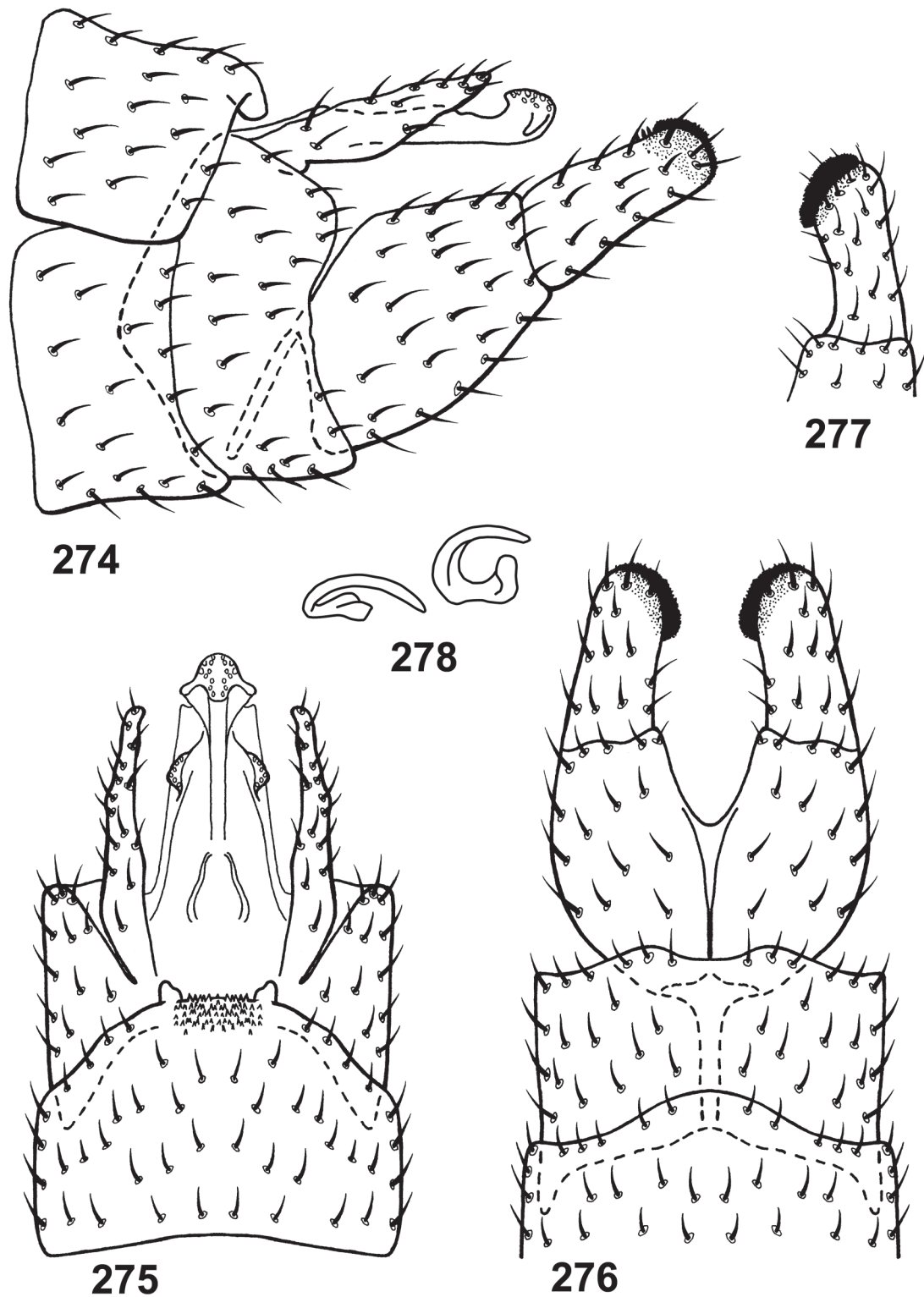
**FIGURES 265–266.** *Wormaldia tocajoma*, new species. Wings: 265, right forewing, dorsal; 266, right hind wing, dorsal.



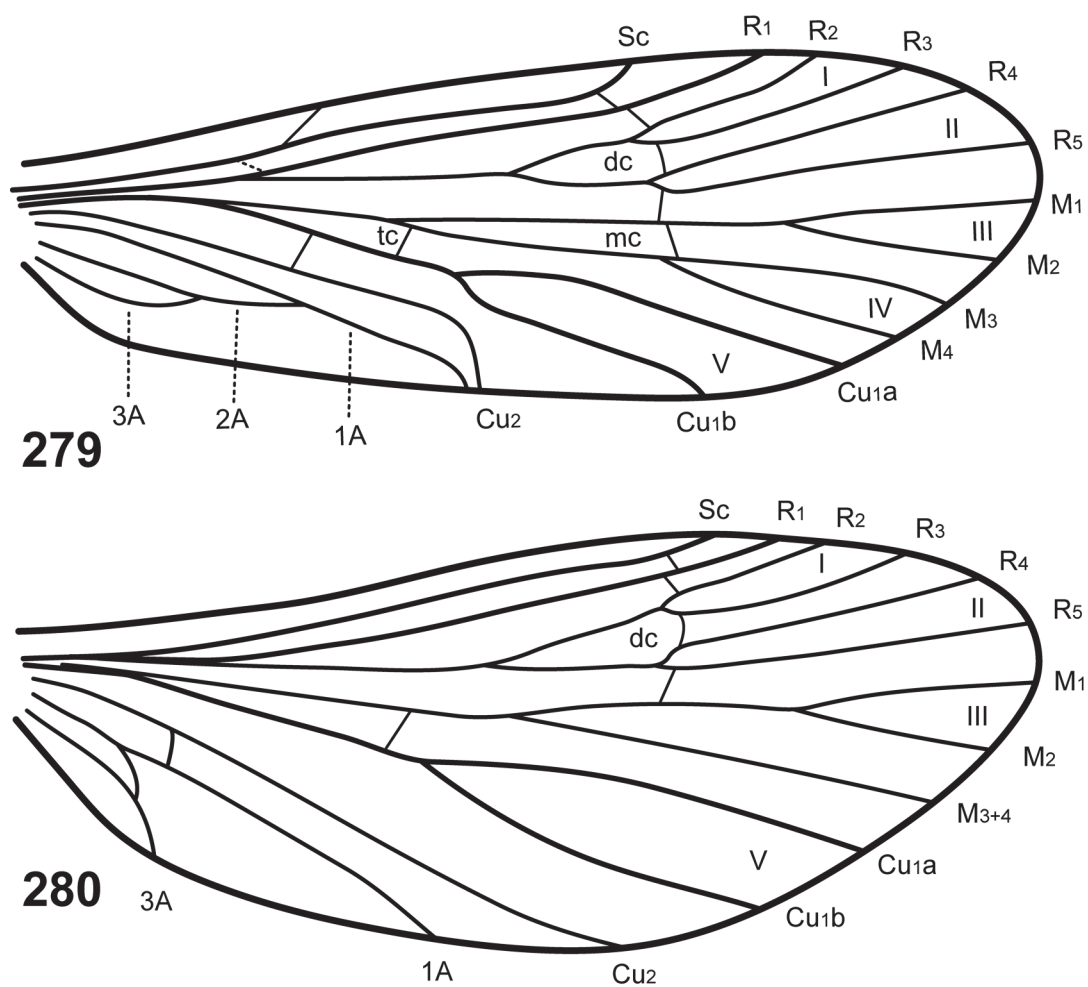
**FIGURES 267–271.** *Wormaldia paprockevi*, new species. Male genitalia: 267, left lateral; 268, dorsal; 269, ventral; 270, apical segment of left inferior appendage, dorsal; 271, phallic sclerites.



FIGURES 272–273. *Wormaldia paprockevi*, new species: 272, right forewing, dorsal; 273, right hind wing, dorsal.

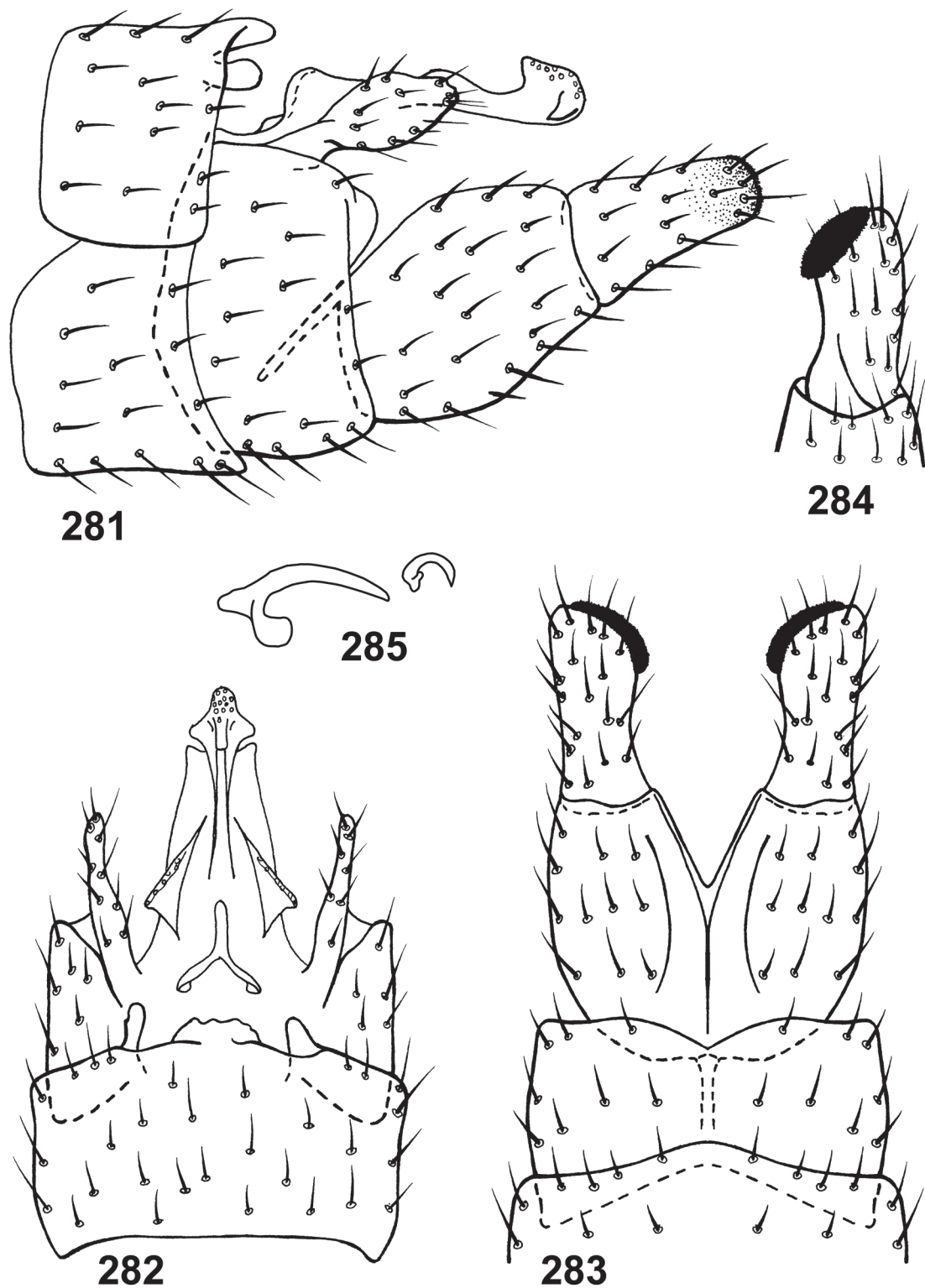


**FIGURES 274–278.** *Wormaldia gonzalezae*, new species. Male genitalia: 274, left lateral; 275, dorsal; 276, ventral; 277, apical segment of left inferior appendage, dorsal; 278, phallic sclerites.

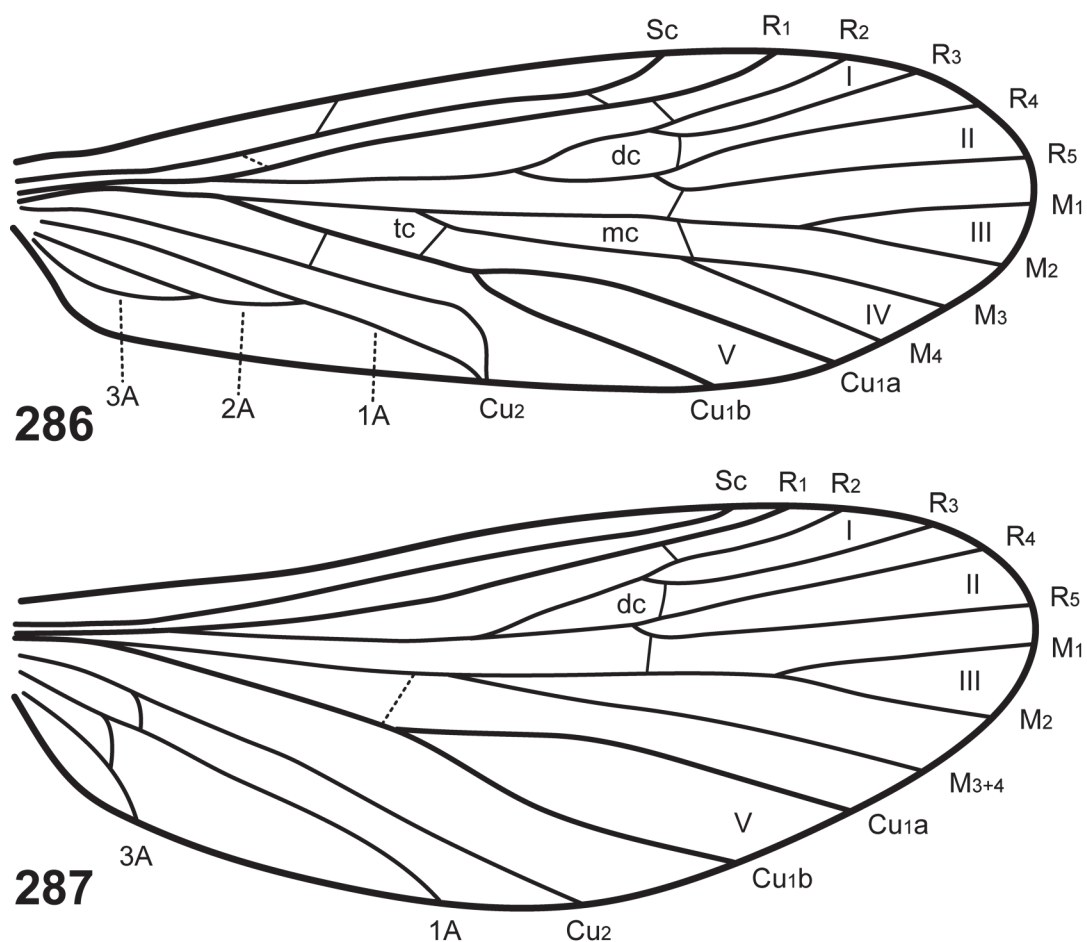


**FIGURES 279–280.** *Wormaldia gonzalezae*, new species. Wings: 279, right forewing, dorsal; 280, right hind wing, dorsal.

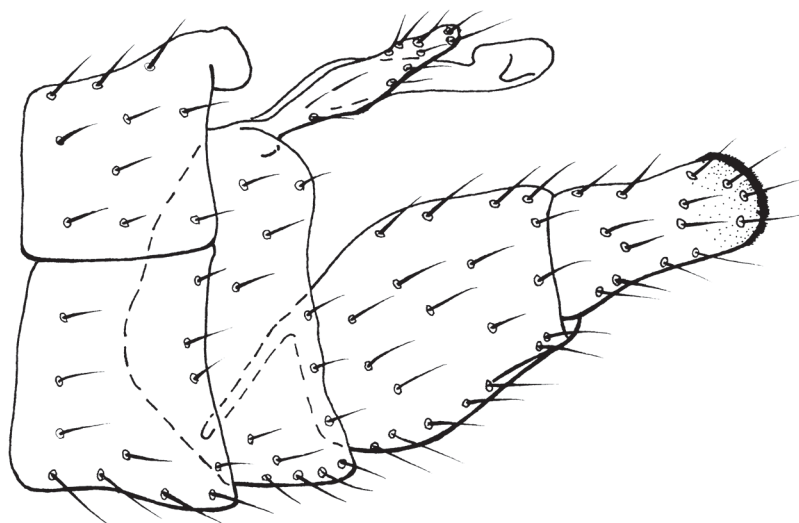




**FIGURES 281–285.** *Wormaldia matagalpa* Flint. Male genitalia: 281, left lateral; 282, dorsal; 283, ventral; 284, apical segment of left inferior appendage, dorsal; 285, phallic sclerites.



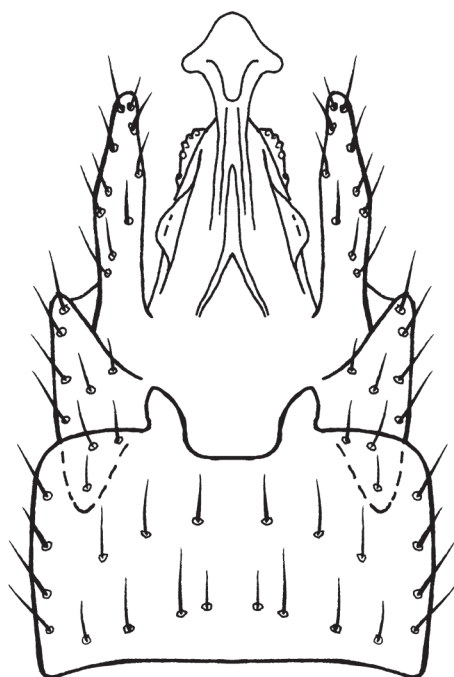
FIGURES 286–287. *Wormaldia matagalpa* Flint. Wings: 286, right forewing, dorsal; 287, right hind wing, dorsal.



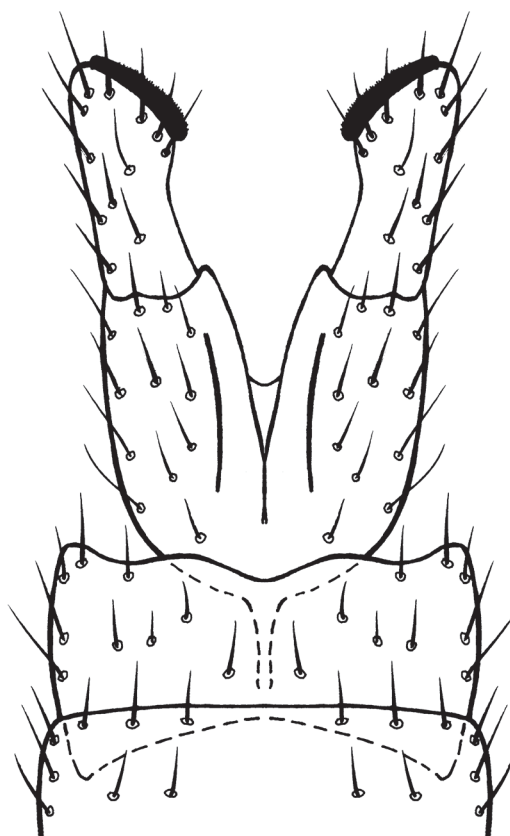
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**FIGURES 288–291.** *Wormaldia arcopa* Denning (synonym of *W. planae* Ross & King). Male genitalia: 288, left lateral; 289, dorsal; 290, ventral; 291, apical segment of left inferior appendage, dorsal.